STANDARD COTTON MILL PRACTICE AND EQUIPMENT

1918

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To the Members of the National Association of Cotton Manufacturers:

We are sending you herewith copy of our first annual Handbook. Do not regard this as the final form in which the book will appear. It is proposed to make it an annual encyclopedia of the cotton industry, containing current statistics and data to which a mill executive may refer at any time, so complete and accurate, but so condensed and classified that those who use it will keep it constantly at hand for quick reference.

The Committee on Publications which has the yearly preparation of the Handbook in charge will welcome all criticisms and suggestions which members of the Association may care to make. It is their earnest request that members give the Secretary not only their opinion of what in the present volume could be omitted and what should be added to future volumes, but also any information in their possession the inclusion of which would make the Handbook of greater interest and value to the industry as a whole. The book can reach its largest usefulness only through the co-operation of all our members.

Very truly yours,

RUFUS R. WILSON,
Secretary.

STANDARD
COTTON MILL
PRACTICE
AND
EQUIPMENT

WITH CLASSIFIED BUYER'S INDEX

1918

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DEVELOPMENTS IN THE COTTON TRADE IN 1917

By Arthur Richmond Marsh
Editor of the Economic World

It is perhaps well to say at the very beginning of this brief survey of developments in the American cotton trade during 1917 that the year's experiences have compelled more extensive and profound readjustments of traditional thinking about cotton than those of any year within the memory of even the oldest members of the trade. The Civil War itself, with its world-wide cotton famine and its sensational advance in the price of the commodity, was much less deeply disturbing to those engaged in the cotton business than the course of events in 1917 has been, because the market abnormalities of the Civil War period were easily explicable on the mere ground of the cutting off of more than two-thirds of the world's cotton supply by the blockade of the South, and the desperate demand for cotton resulting therefrom in all the countries in which the cotton industry had been highly developed. The essentially temporary and exceptional character of what was occurring was apparent to all eyes; no questions were raised as to the ultimate adjustment of the production of cotton to the world's requirements, or as to the restoration, soon after the coming of peace, of substantially the same parity between the price of cotton and the normal cost of producing it that existed for many years before the war.

FORCES AT WORK

In 1917, on the other hand, there have seemed to be mysterious and inscrutable forces at work in the cotton markets both of the United States and of other cotton-producing and consuming countries—though especially in the markets for American cotton. There was during the entire year no actual or seriously threatened scarcity of cotton of American growth—except, of course, in the blockaded Central Powers. It is true that the American crop of 1917 was the third relatively small crop in succession—an almost unprecedented occurrence; and if the world had been at peace the available supply would have been most uncomfortably small. The war, however, had brought about a proportional diminution of the effective demand for consumption, primarily through the complete exclusion of Germany and Austria-Hungary from all sources of supply, and secondarily through the enforced reduction of cotton-manufacturing operations in several European countries difficult of access owing to the effects of the German submarine cam-

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paign. Hence, despite the shortness of the production of cotton in the United States, the normal balance between the effective demand for American cotton and the available supply of it was not seriously disturbed in 1917. According to all the traditional market criteria, therefore, no visible reasons existed for price movements that should swing far outside the orbit of all past experience, departing widely from the curve that would naturally be produced by the customary factors of price determination.

PHENOMENAL PRICE MOVEMENTS

It may be said that the past year's profound disturbance of thinking among the experienced members of the cotton trade, of which mention has been made, was in the main the result of their inability to reason upon any other basis than that just described, while they had ocular demonstration in the actual course of the markets from week to week and from month to month that some fallacy lurked in this reasoning and that market conclusions drawn from it could not be counted upon to prove correct in the event. Causes beyond their ken were evidently making all their traditional criteria worthless; the upward movement of the price of cotton went irresistibly on, far overpassing all metes and bounds they might set for it in their own minds as representing the extremest possibilities of the demand and supply situation, on the one hand, and of the economic and commercial relativity of price to cost of production, on the other hand. Perhaps most puzzling of all was the apparent failure of the upward price movement to bring into play at any point in the advance the economic and social forces that normally curtail the consumption of an important raw material and its products as the price (or scale of prices) becomes disproportionate to the consuming public's traditional estimate of value or to the potentialities of the average family budget. In the years before the war the effects of these price-restraining forces had always manifested themselves speedily and sharply when for any cause the price of cotton rose materially above the customary level; but in 1917 they seemed to be wholly inoperative. Though the price of cotton advanced to twice its scarcity value in the pre-war days, while the prices of cotton products were steadily enhanced until they were three, four, and even in some cases five times what the present generation had previously known, there was no perceptible diminution of the demand for either raw cotton or cotton goods. For those engaged in the cotton trade this fairly bewildering phenomenon could scarcely fail to raise the question whether all precedent has not for obscure reasons become useless and valueless as a means of guidance for the future—that is, whether the circumstances

of the war have not abruptly ushered in a new era for cotton, with its new price criteria and its co-ordination of production and consumption on a new basis of values, irrespective of traditional conceptions of what should result from given supply and demand situations.

COURSE OF THE MARKETS HERE AND ABROAD

Though the movement of the price of cotton in 1917 can be conveniently followed in tables given elsewhere in this volume, it will perhaps make for clearness in this résumé to review briefly the course of the more important markets in this country and Great Britain from the beginning to the end of the year. This is the more desirable since in early months of the year there was little suspicion in the cotton trade of the existence of any other price-determining factors but those with which the trade was quite accustomed to deal. It is true that in 1916 there had been a very active "bull" speculation in cotton, inspired in part by the prospect of a very short crop in the United States, and in part by recurrent rumors of the early coming of peace in Europe, an event which was expected to be followed immediately by the opening of the German and Austrian markets and a huge temporary demand for cotton to replenish the stocks of those countries. This "bull" speculation had carried the price of cotton, towards the end of 1916, to what was commonly regarded by the trade as a necessarily impermanent level —about 22½ cents a pound in New York and rising 20 cents a pound in the Southern markets; but opinion was virtually unanimous in attributing this great rise to ordinary speculation carried to an indefensible extreme, and in holding that the inevitable aftermath of the speculation would be a decline approximately as severe as the advance had been. Given a reasonably abundant American crop in 1917, the trade believed that the reduction in consumption due to the Allies' blockade of Germany and Austria, and the restriction of free exportation from the United States by reason of the shortage of ocean tonnage and the submarine danger, would leave the American markets overburdened with cotton and would completely preclude any but the most moderate prices for the staple.

EFFECT OF SUBMARINE WARFARE

In the early weeks of 1917 these ideas so wholly dominated the American cotton trade that the tendency of prices was steadily downward; and on the well-remembered day, February 2, this downward movement culminated in perhaps the most spectacular break in prices ever experienced by the American cotton exchanges. The announcement of the German Government on February 1 that it proposed to conduct its

submarine warfare without regard for international law or the rights of neutral countries precipitated an over-night decline of more than 5 cents a pound in the price of cotton future contracts in New York and threatened for a time to bring about complete demoralization in the cotton trade of the United States. Apart from the immediate financial consequences for a large number of members of the cotton trade, the commercial and economic interest of this remarkable break in the price of cotton in early February lies in the fact that the lowest price touched—12½ cents a pound in New York—was a perfectly normal pre-war price for cotton, at least in years when the supply was neither excessive or inadequate. In fact, the average quoted price of middling cotton in New York for the decade preceding the outbreak of the war was between 11⅞ and 12 cents a pound. The close return to this pre-war price on February 2, 1918, was naturally interpreted by the great majority of experienced persons in the cotton trade as marking the end of the speculative fever and of the inordinately high prices of 1916; and it was confidently expected that when the marketing of the 1917 crop should begin, approximately the old scale of values would be found effective—though, of course, intermediary price fluctuations might depart more or less extensively from this level.

UNPRECEDENTED RISE IN PRICE

It is scarcely necessary to state that these anticipations of the cotton trade were completely belied by what actually happened in respect of the price of cotton as the successive months of 1917 came along. The year was marked, not by a final return of the price of cotton to its average pre-war level,—or, indeed, to any level obtaining for nearly a half-century before the war,—but by an almost uninterrupted rise of the price, so irresistibly persistent that it remained unchecked by any of the influences or occurrences which in other days would infallibly have brought it to a halt and have turned the price movement in the opposite direction. Military and political reverses and disappointments affecting the entire cotton-consuming world, interruptions of transportation by land and sea, compulsory curtailments of manufacturing operations in important consuming countries, the gradual demonstration of the existence of supplies of cotton amply adequate for the requirements of the current season, threats of governmental interference with the movement of prices, increasing anxieties with regard to the effects of the German submarine warfare upon the distribution of cotton to the countries needing it—no one of these things, nor all of them together, sufficed to stay for more than a brief space of time the incessant enhancement of the market value of this chief of all textile raw materials.

SEASONS FOR RISE IN PRICE

It is the first thought of the majority of persons, of course, that the great rise in the price of cotton is after all but part and parcel of that general advance in the prices of commodities which has been one of the most striking economic features of these years of war, and that it is attributable to the same causes that produced that general advance. Foodstuffs and metals, the most important commodities of a primary utility similar to that of the textile raw materials, have notoriously risen in price by from 100 to 200 per cent.—in some cases even more. In fact, the index numbers of commodity prices in all countries have risen nearly, if not quite, proportionally to the increase of the price of cotton. On the face of the figures there is no important difference between cotton and all other essential articles of commerce. This reasoning, however, neglects the primary fact that the demand and supply situation of cotton has at no time resembled that of the foodstuffs, the metals, and various other commodities necessary for the carrying on of war or for the sustenance of the belligerent populations. When the world's production and distribution of foodstuffs decline and are disturbed, as they have been during the past two years and more, to such an extent that hundreds of millions of human beings are but a step removed from actual dearth of food, there is nothing surprising in a rise of 100 or 200 per cent. in the prices of the more important foodstuffs. Similarly, when warfare on an unheard-of scale creates an insatiable demand for the metals, whether in their raw or in their finished form, compelling the extension of existing mines and the opening of new ones, as well as the indefinite enlargement of metallurgical establishments of every kind, almost any advance in metal prices is easily explicable. In both these instances the price phenomena may be accounted for very simply on the ground of an overwhelming pressure of demand upon a supply which either is absolutely declining to the danger point or is capable of expansion only with comparative slowness.

LESS DEMAND THAN BEFORE THE WAR

The case of cotton, however, has been almost devoid of these characteristics. The war has not increased the demand for cotton, but has very substantially diminished it. Two of the most important cotton-consuming countries, Germany and Austria-Hungary, have virtually been precluded from obtaining any cotton at all for the past two years; while of the countries outside the iron ring of the blockade all but two, the United States and Japan, have been compelled by force of circumstances to curtail their consumption of cotton to an important ex-

tent, at least during the past year and a half. Consequently, though the three successive short crops in the United States and some decline in production in Egypt reduced the supply below the normal demand in time of peace, it still remained true that the supply was not diminished proportionally more than was the demand. Hence it cannot be argued, as a matter of plain economics, that the pressure of an excess demand upon a clearly inadequate supply produced the remarkable effects in the way of high prices which have fairly bewildered the majority of persons in the cotton trade.

PROBLEMS OF THE MANUFACTURER

It is clear that the problem, primarily commercial but in a larger sense economic, presented by the movement of the price of cotton during the past year is one of very great importance, not only from the point of view of the manufacturers and merchants of cotton in the United States, but also from that of what may be called the world's general cotton economy. After half a century of experience with its production and distribution cotton had found a certain place in the world's commercial and industrial organism. The relativity of its price to the prices of other commodities of primary necessity had become established within comparatively narrow limits. While the seasonal nature of cotton production created considerable variations of the supply from year to year, and these variations of the supply resulted in corresponding temporary fluctuations in market values, the cotton industry of this and other countries was able to preserve without difficulty the continuity of its operations, because a moderate rise or fall of the price from the average level was sufficient to stimulate production to an adequate extent after years of short production and supply, or to check production after years of superfluity. Accordingly, cotton manufacturers, as well as the merchants who supply them with their raw material, were able to calculate ahead with a reasonable assurance of correctness and to make commitments for the more or less distant future without having to face the risk of ruin by reason of extraordinary variations in the market values of the products in which they were dealing. The same rule applied throughout the entire complex organization for the distribution of the products of cotton to the ultimate consumers of these products. The generally known and fairly dependable price basis for raw cotton afforded at every point in the long-drawn-out process of manufacture and distribution a kind of insurance against that order of losses that peculiarly affects the industrial and commercial classes, *i.e.*, losses due to excessive and unanticipated changes, not in intrinsic values, but in market values or prices. With this insurance—in a

sense psychological, yet none the less very real and effective—the operations of manufacture and distribution in connection with cotton could be conducted from year to year within proper bounds of commercial and financial safety; the moderate profits of one season were more than sufficient to make good the moderate losses that might be incurred in another season. Success or failure rested with the individual and not with the effects of uncontrollable and unforeseeable outside forces.

PRESENT UNSETTLED CONDITIONS

The extravagantly wide departure in 1917 of the price of raw cotton, and the still wider departure of the prices of the manufactured products of cotton, from the levels that for many years had been esteemed normal and calculable creates a problem of the first magnitude for the cotton trade and industry for the very reason that it appears to have destroyed all the old landmarks and to have impaired profoundly the quasi-insurance against inordinate price losses which has just been described. It is true that the departure has been in the upward direction and that its immediate result for those concerned has been an astonishing enhancement of profits for the time being. But what of the permanency of the great price change? What of the persistence of the forces that have brought it about? What of the possibility of an equally severe change in the opposite direction—a change which from its nature would occasion losses as disheartening as the present profits are exhilarating? If the high upreared price structure of recent months were to be undermined and shaken, upon what price basis could manufacturers and merchants depend as economically warrantable and commercially safe? Must there be in that case a complete return to the pre-war price levels, with all the tremendous shrinkage in values such a decline would imply? Or has a really new order of things in connection with cotton been brought about by the war, and does this new order of things imply the abandonment of the traditional price criteria and the substitution therefor of newer and higher conceptions of value? These and similar questions the thinking men in the cotton trade and industry are now putting to themselves, and their uncertainty of mind about the future largely arises from the obscurity of the facts that underlie the questions and the consequent difficulty in arriving at answers to the questions that are at all convincing. No inconsiderable number of persons in the trade, of course, take what each day brings, without much forethought about what may lie ahead; but the *mot d'ordre* of the day is preparation for the future, and it is perceived by those who recognize this duty with respect to cotton, that the questions raised by the events of 1917 in connection with this commodity may not lightly be dismissed.

It goes without saying that it would be the height of foolhardiness to undertake to give the answers to these questions out of hand. Yet it is worth while to attempt some analysis of the influences which have been visibly operative in the markets for cotton and cotton goods during the past twelve or eighteen months, with a view to differentiating between them, defining them as far as possible, and distinguishing those of them that must be regarded as more or less permanent from those that are evidently impermanent, as obviously due to the particular circumstances and conditions of this time of war. Perhaps it will make for clearness to deal first with the influences belonging to the second of these categories.

PERMANENT INFLUENCES

Looking back to the beginning of the war and then recalling what has happened to the price of cotton as the war years advanced, one is almost painfully impressed by the universality of the early misreading of the future course of events in the cotton markets. In the first months of the war there was scarcely an exception in the trade to the fixed belief that the war would mean very low prices for cotton throughout its duration. In corroboration of this belief, it was pointed out that, while war may bring abnormally high prices for those commodities and articles required for military and naval use, its effect upon the civil populations directly or indirectly involved in it must necessarily be to curtail their purchasing and consuming ability. The essence of war, it was urged, is waste upon an enormous scale; and this waste in the last resort is at the expense of those members of society who are called upon to bear the burden of taxation, to supply from their economies the funds needed for the prosecution of the war, and to accommodate their lives to the cramped conditions imposed by war upon general industry and trade. Then, huge numbers of men are withdrawn by war from their usual pursuits and their regular expenditures, for themselves and their families, and while they may be furnished by their governments with certain quantities of wearing apparel and the like, their consumption of such articles will be nothing like what it would be, were they working and earning in the normal way. Furthermore, it was from the outset apparent that certain of the belligerent countries—Germany and Austria, in particular—were certain to be cut off for the most part from the supplies of cotton necessary to run their mills, so that a curtailment of consumption amounting to a large percentage of the entire cotton consumption of the world would automatically ensue. Inasmuch as there was no reason for supposing that the war would interfere in any way with the production and distribution of cotton, it seemed to follow that during the war the world would have continuously a normal supply

over against a greatly diminished demand, and that a persistently low price for cotton would be the unavoidable result. That these assumptions might prove to be essentially correct, at least as regards their major premises, and yet that one war factor after another might come into play to upset the conclusions drawn from them, causing the price of cotton to move steadily and at last violently upward in defiance of all prognostications, was long an outcome beyond the reach of even the most optimistic imaginations.

LOOKING BACKWARD

Scanning the cotton history of the war years in retrospect, it is curious to note to how large an extent the price-enhancing influences due to the war have belonged to the psychologic, rather than to what is commonly thought of as the economic, order of things; and how often what may be called a psychologic inference looking to the future has proved stronger than a strictly economic interpretation of present fact. One of the earliest illustrations of this seeming substitution of the irrelevant for the relevant was the turning of the very blockade of the Central Powers into a bullish argument as regards the price of cotton. The blockade, to be sure, produced an immediate reduction in the consumption of cotton; but, on the other hand, it came to be argued, the dearth of cotton and cotton goods in Germany and Austria, as a result of the blockade, must be interpreted in terms of the enormous demand from those sources that would come into the markets the moment peace was declared. The sudden pressure of this demand must mean an advance in the price of cotton of unprecedented proportions, and those fortunate enough to be the owners of cotton when this advance should come would find themselves the possessors of fortunes over night. Hence a widespread desire to share in this purse of Fortunatus, a universal confidence on the part of holders of cotton, and a general disposition to purchase cotton well before the anticipated event. Every rumor of an early peace, moreover, stimulated fresh buying by all sorts and conditions of persons; and the more complete the shutdown of German and Austrian cotton mills, the greater the confidence in the profitable working out of the theory and the higher the price level attained in the cotton markets. Furthermore, when the oft-revived anticipations of an early peace too consistently came to naught, the growing scarcity of cotton and cotton goods in the Entente and neutral countries of Europe and in the other important consuming markets of the world, was turned to in justification of ever higher prices for cotton, on the ground that the ultimate relieving of this scarcity would involve an even more extensive and more insistent demand for

the commodity than that which had at first been associated with Germany and Austria with their industry and commerce open to the world once more.

WAR INFLUENCES IN THE COTTON MARKET

Another illustration of the psychological character of the war influences in the cotton markets is to be found in the remarkable effects produced by price analogy pure and simple. To begin with, the high prices for foodstuffs and neutrals produced by the war demand, on the one hand, and by a world scarcity, on the other, have powerfully affected men's opinions with respect to the market value of cotton, no real scarcity of which existed and the war demand for which was offset by the decrease in the civilian consumption. Because the price of wheat was doubled and even trebled in the United States, because copper rose in value 100 per cent or more, and many steel products 200 and 300 per cent, a proportionate advance in the price of cotton was held to be warranted; and enough owners of cotton and dealers in it took this view to make their feeling effective in a market way, irrespective of the demand and supply situation of cotton itself.

PRICES IN EUROPE AND AMERICA

Perhaps even more striking has been the analogical effect on the price of cotton in all the important producing countries, of the very exaggerations of price in the consuming countries of Europe, due to the effects of the war, and especially of the German submarine campaign, in the way of enormously enhanced ocean freight rates and marine insurance charges, as well as to the continuous limitation of European cotton stocks through the scarcity of available ocean tonnage. At first sight it would seem that the greater the difficulty and expense attending the exportation of cotton from the United States, for example, to Great Britain, France, and the other Continental countries, the greater the burden of the immediate supply of cotton on the American markets and the lower the relative, and perhaps the absolute, price in these markets. Under the pre-war conditions it would certainly have been the case that a rise of 400 to 500 per cent in marine insurance rates between American ports and Liverpool and an even greater increase in ocean freights would have led to a prompt decline in the price of cotton in this country, despite any compensatory advance that might occur in Great Britain. During the past two years, however, the higher and higher prices quoted in Liverpool have invariably been taken as warranting an advance, rather than a decline, on this side of the Atlantic, irrespective of the simple commercial explanation of the Liverpool

advance. Similarly, the even higher prices quoted in the Continental markets have steadily served as a stimulus to rising prices in the United States, even though it was apparent at a glance that the abnormalities of the Continental prices were directly due to inability to secure cotton from this country and therefore really meant just so much more cotton to be warehoused, financed and disposed of here. It is true, of course, that the price advances of this character were far from being as extensive in the United States as in Europe, the so-called parities, or market differences, widening to totally unprecedented figures; but the essential point is, after all, that American prices did advance, and did not decline, with virtually every increase in ocean freight and marine insurance rates. In other words, the analogy of the more and more extraordinary prices obtaining for cotton abroad was a more powerful influence towards determining the price in the United States than was the essentially bearish situation created in the United States by the commercial factors that induced the European advance.

OTHER WAR INCIDENTS AFFECTING COTTON

A variety of other incidents of the war, which directly or indirectly affected cotton, might be mentioned as tending to enhance the market value of cotton out of all proportion to their commercial importance measured statistically, *i.e.*, as disturbing the balance of available supply and effective demand. Such an incident was the diversion of virtually the entire production of linters—and probably of some quantity of very low cotton and mill waste—from the rather inconsequential pre-war uses to the manufacture of explosives. From time to time very exaggerated notions became current as to the reduction of cotton proper for mill use that was being thus occasioned. The fallacy of the premise, however, though more and more clearly demonstrated as time went on, did not prevent the conclusion from influencing the price of all cotton in an upward direction. In the same way, all orders of the belligerent governments for cotton goods and products for military and naval purposes had a most powerful effect upon ideas of price, even when, statistically speaking, the proportion borne by the goods and products so ordered to the total production was not very large—in fact, was not large enough in other countries than the United States to offset the demonstrable falling off in the civilian consumption.

PSYCHOLOGICAL INFLUENCES

While from a purely supply and demand standpoint, therefore, the war itself cannot be said to have produced so acute a situation in respect of cotton as directly to account for the extraordinary advance in

the price of the commodity, the psychological influences brought into operation by the war in the cotton markets have been virtually without exception such as to make persistently and powerfully in the direction of higher values. Largely by reason of these psychological influences, all argumentation of the traditional kind designed to bring the markets back to commercial and economic considerations proper, and to induce an ebb of the price tide, has proved to be inconsequential and futile. The conclusive fact is that in the markets of the United States the price of American cotton is at the time of this writing nearly—and in some cases quite—200 per cent higher than its average for the decade before the war; that in Great Britain it is over 300 per cent higher; and that in certain of the unblockaded European markets it is more than 400 per cent higher. And this is the case notwithstanding that, statistically considered, the supply of American cotton is amply sufficient to carry the world's cotton manufacturers through to the marketing of the coming season's crop.

PRICES OF YARNS AND CLOTHS

It should now be said that the operation of the war influences described above has not been confined to the markets for raw cotton, but that it has been even more in evidence in the markets for cotton products of all kinds. It is notorious that the advance in the price of cotton itself has been proportionally far less than the advance in the prices of cotton yarns and cloths; and this is true of every country in the world. There has perhaps never been a year in the history of the cotton manufacturing industry in which what are commonly called "spinners' margins"—*i.e.*, the differences between the selling prices of the various goods and the cost of the raw material plus manufacturing cost—have been so wide as they have been in 1917; and there certainly never has been a year in which the margins have so consistently grown wider and wider, when both the cost of raw material and manufacturing costs were uninterruptedly rising beyond all precedent. It will not be attempted here to analyze and segregate the causes of this most striking industrial and commercial phenomenon. What is most astonishing about it is that it has opened up an entirely new order of ideas with respect to the level of prices for cotton products which the consuming population of the world will accept, if it has to—and this without any drastic curtailment of its purchases. As has been said above, the civilian consumption of cotton goods has demonstrably declined somewhat in practically all countries except the United States; yet the falling off has been too inconsiderable to permit of serious accumulations of goods in any of the markets, or to check the rise of prices.

RECIPROCAL PRICE INFLUENCE

It goes without saying that the sympathetic effect of the price movement in the goods markets upon the price of raw cotton has been very great and that it has powerfully fortified the influences tending to force higher and higher the price of cotton itself. It is a general economic principle that only a superfluity of a given commodity can prevent its price from moving almost irresistibly to the highest level that the consumers of it can afford to pay; and the known ability of cotton manufacturers to pay far more for cotton than they have at any time been called upon to pay, has been a magnet continuously acting with great strength upon the price of cotton. Economically speaking, the cotton and cotton goods markets of 1917 have afforded one of those comparatively rare but always interesting cases of reciprocal price influence, every advance in the one promptly inducing an advance in the other.

THE FUTURE

To what lengths this parallel price movement may go it would be idle to attempt to forecast. At some point, of course, the restriction of the civilian consumption of cotton goods all over the world will become so extensive, as a result of the pressure of war costs, felt through taxation and in numerous other ways, that the producing power of the manufacturers will overtake and pass the absorptive power of the markets. Naturally, when this point has been reached—though it must be admitted that as yet there is no clear sign of it—the upward price movement of both cotton goods and cotton will be checked, and the process of return to normality will be begun. It may be doubted, however, whether the new normality will be found to correspond with that established and accepted before the war. For the war will certainly leave behind it great displacements of labor and capital, profound readjustments as between the various classes of producers and consumers in every part of the world, far-reaching new correlations of the different kinds of productive industry, and extensively altered measures of value for the products and services of those concerned with the various productive occupations. Unless all signs fail, the agricultural production and all that harks back to it will be found after the war in a relatively better position than that which has to do with any of the other forms of production or service to society. It may, therefore, easily prove to be the case that the happenings of 1917 in connection with cotton and its products are really significant of a new state of things which will persist for a very long time.

PRODUCTION, CONSUMPTION, EXPORTS, AND NET IMPORTS OF RAW COTTON, FOR THE UNITED STATES: 1877-1916

(United States Census Data)

Year	Cotton Production (Exclusive of Linters)		Consumption of Cotton and Linters (equivalent 500-pound bales)	Exports of Domestic Cotton (equivalent 500-pound bales)	Net imports (equivalent 500-pound bales)	Percentage of exports to total crop
	Running bales, counting round as half bales	Equivalent 500-pound bales, gross weight				
1916	11,363,915	11,449,930	7,721,354	5,963,682	288,486	52
1915	11,068,173	11,191,820	7,326,598	6,405,993	420,995	57
1914	15,905,840	16,134,930	6,087,338	8,931,253	363,595	55
1913	13,982,811	14,156,486	5,942,808	9,256,028	265,646	65
1912	13,488,539	13,703,421	5,867,431	9,199,093	225,460	67
1911	15,553,073	15,692,701	5,400,005	10,681,332	229,268	68
1910	11,568,334	11,608,616	4,713,126	8,025,991	231,191	69
1909	10,072,731	10,004,949	4,759,364	6,491,843	151,395	65
1908	13,086,005	13,241,799	5,198,963	8,889,724	165,451	67
1907	11,057,822	11,107,179	4,493,028	7,779,508	140,869	70
1906	12,983,201	13,273,809	4,974,199	8,825,236	202,733	66
1905	10,495,105	10,575,017	4,877,465	6,975,494	133,464	65
1904	13,451,337	13,438,012	4,523,208	9,057,397	130,182	67
1903	9,819,969	9,851,129	3,980,567	6,233,682	100,298	63
1902	10,588,250	10,630,945	4,187,076	6,913,506	149,113	65
1901	9,582,520	9,509,745	4,080,287	6,870,313	190,080	72
1900	10,102,102	10,123,027	3,603,516	6,806,572	116,610	67
1899	9,393,242	9,345,391	3,687,253	6,167,623	134,778	66
1898	11,189,205	11,435,368	3,672,097	7,626,525	103,223	67
1897	10,897,857	10,985,040	3,472,398	7,811,031	105,802	71
1896	8,532,705	8,515,640	2,841,394	6,124,026	114,712	72
1895	7,161,094	7,146,772	2,499,731	4,761,505	112,001	67
1894	9,901,251	10,025,534	2,983,665	6,961,372	99,399	69
1893	7,493,000	7,433,056	2,300,276	5,307,295	59,405	71
1892	6,700,365	6,658,313	2,415,875	4,485,251	85,735	67
1891	9,035,379	8,940,867	2,846,753	5,896,800	64,394	66
1890	8,652,597	8,562,089	2,604,491	5,850,219	45,580	68
1889	7,472,511	7,472,511	2,518,409	4,928,921	18,334	66
1888	6,938,290	6,923,775	2,309,250	4,730,192	15,284	68
1887	7,046,833	6,884,667	2,205,302	4,519,254	11,983	66
1886	6,505,087	6,314,561	2,049,687	4,301,542	7,552	68
1885	6,575,691	6,369,341	2,094,682	4,200,651	8,270	66
1884	5,682,000	5,477,448	1,687,108	3,783,319	7,144	69
1883	5,713,200	5,521,963	1,813,865	3,733,369	11,247	68
1882	6,949,756	6,833,442	2,038,400	4,591,331	4,716	67
1881	5,456,048	5,136,447	1,849,457	3,376,521	3,261	66
1880	6,605,750	6,356,998	1,865,922	4,453,495	5,447	70
1879	5,755,359	5,466,387	1,500,688	3,742,752	7,578	69
1878	5,074,155	4,745,078	1,457,266	3,290,167	5,049	69
1877	4,773,865	4,494,224	1,458,667	3,197,439	5,046	71

COTTON PRODUCTION, POUNDS PER ACRE, BY STATES: 1906-1917

(United States Department of Agriculture Data)

	1917	1916	1915	1914	1913	1912	1911	1910	1909	1908	1907	1906	1905
United States	156	157	170	209	182	191	208	171	154	195	178	203	186
Alabama	110	79	146	209	190	172	204	160	142	179	169	165	173
Arkansas	162	209	180	196	205	190	190	175	153	215	195	215	172
California	275	400	380	500	500	450	390	335					
Florida	105	105	120	175	150	113	130	110	110	112	115	95	144
Georgia	173	165	189	239	208	159	240	173	184	190	190	165	200
Louisiana	218	170	165	165	170	193	170	120	130	145	210	272	170
Mississippi	153	125	167	195	204	173	172	182	157	233	228	215	190
Missouri	175	225	240	270	286	260	360	285	271	340	275	285	294
North Carolina,	187	215	260	290	239	267	315	227	210	211	205	201	240
Oklahoma	150	154	162	212	132	183	160	200	147	143	200	217	215
South Carolina,	205	160	215	255	235	209	280	216	210	219	215	175	220
Tennessee	115	206	188	200	210	169	257	207	158	218	190	180	212
Texas	135	157	147	184	150	206	186	145	125	196	130	225	164
Virginia	170	310	225	265	240	250	330	212	190	210	190	185	204

WORLD'S PRODUCTION OF COTTON: 1913–1917

(Commercial and Financial Chronicle Estimates)

Country	500-Pound Bales produced for the Year ending July 31				
	1917	1916	1915	1914	1913*
Total	17,990,099	17,253,960	19,578,954	20,914,660	19,197,979
United States	12,670,099	12,633,960	14,766,467	14,494,762	13,943,220
India	4,100,000	3,490,000	3,337,000	4,592,149	3,468,407
Egypt	950,000	910,000	1,235,487	1,439,802	1,416,352
Other countries	270,000	220,000	240,000	387,947	370,000

* Year ending August 31.

PRODUCTION OF COTTON BY STATES, LINTERS EXCLUDED: 1900–1916*

(Thousands of running bales, except that round bales are counted as half bales)

State	Year																
	1916	1915	1914	1913	1912	1911	1910	1909	1908	1907	1906	1905	1904	1903	1902	1901	1900
United States	1136	1107	1591	1398	1349	1555	1157	1007	1309	1106	1298	1050	1345	982	1059	958	1010
Alabama	55	103	173	148	133	170	119	104	133	111	124	123	145	99	97	111	103
Arkansas	110	79	100	104	77	91	80	70	100	75	89	60	90	72	95	71	80
Florida	5	6	9	7	6	9	7	6	7	6	6	8	9	6	7	6	6
Georgia	185	194	227	235	181	279	181	185	198	186	163	173	196	131	148	137	126
Louisiana	44	34	45	44	57	38	25	26	47	66	96	51	108	82	87	84	71
Mississippi	80	93	122	125	100	117	121	107	162	144	148	117	177	141	142	125	104
North Carolina	69	74	97	84	91	113	75	63	68	64	61	65	75	56	57	45	51
Oklahoma	81	62	123	84	100	102	92	55	69	85	87	66	80	46	53	37	35
South Carolina	97	117	156	142	122	169	121	114	122	116	91	111	119	81	95	73	78
Tennessee	38	30	37	37	27	43	32	24	33	27	29	27	32	24	31	19	22
Texas	356	307	439	377	465	411	295	247	363	221	396	243	306	241	243	245	332
All other	15	10	17	12	9	14	8	6	7	5	7	6	6	5	6	4	3

* United States Census Data.

Quantities and Values of Annual EXPORTS of COTTON CLOTH of U. S. Manufacture

(Compiled from United States Commerce Report)

	Twelve Months Ending June 30					
	1917		1916		1915	
Manufacturers of Cloths—	*Yards*	*Value*	*Yards*	*Value*	*Yards*	*Value*
Unbleached	157,095,028	$16,332,522	176,340,674	$17,485,963	157,741,806	$12,292,261
Bleached	101,506,374	10,611,025	76,496,166	5,985,657	53,138,547	3,854,039
Colored—						
Printed	148,408,387	12,378,566	130,648,408	8,303,925	72,600,748	4,185,404
Dyed in the piece	60,312,429	7,540,134	39,646,447	3,762,774	31,397,862	2,787,147
All other	222,711,342	25,743,049	127,487,203	10,875,881	82,065,232	5,563,664
Total cloths	690,093,560	$72,605,296	550,618,898	$46,414,200	396,944,195	$28,682,515
Exported to—						
United Kingdom	5,579,412	$2,207,003	23,686,781	$6,171,485	14,701,725	$2,977,282
Canada	76,342,865	10,077,098	55,477,534	5,755,264	24,634,467	2,247,599
Central American States and British Honduras	68,601,722	5,428,335	43,658,494	2,784,963	30,988,700	1,817,799
Mexico	74,398,834	7,871,244	40,448,536	2,873,866	6,334,501	521,744
Cuba	58,194,600	5,737,149	60,639,008	4,262,801	40,683,670	2,672,117
Haiti	24,796,499	2,332,675	27,543,798	2,048,310	10,627,039	758,145
Other West Indies and Bermuda	43,630,582	4,124,637	35,739,382	2,371,080	31,791,028	1,950,813
Argentina *	37,104,274	4,225,513	14,910,804	1,601,165	—	—
Brazil	5,467,569	800,325	1,763,717	226,501	423,250	42,899
Chile	27,272,404	2,687,222	12,211,320	851,651	6,780,257	455,420
Colombia	32,283,630	2,628,601	33,561,578	1,877,419	14,556,626	711,136
Other South America	63,975,667	6,363,448	29,273,532	2,127,578	14,010,762	998,844
Aden	16,962,000	1,132,067	20,692,413	1,011,040	29,532,109	1,477,222
China	3,831,494	358,911	11,812,618	842,510	17,047,095	1,194,930
British East Indies	7,028,532	721,643	14,886,874	1,164,975	14,999,199	1,025,703
Hongkong	734,670	110,270	519,531	92,077	184,083	30,171
Australia †	14,477,530	1,898,923	15,700,831	1,783,900	7,698,289	917,179
Philippine Islands	86,560,139	7,888,497	73,083,748	4,872,051	106,760,121	6,633,590
Other Asia and Oceania	8,985,520	1,287,952	2,601,078	271,418	707,069	79,802
Other countries	33,865,617	4,723,783	32,407,321	3,424,146	24,484,105	2,168,320

* Not separately stated prior to Jan. 1, 1916.

† Includes New Zealand and other British Oceania.

EGYPTIAN COTTON: ACREAGE AND PRODUCTION: 1902-1916

(Ministry of Agriculture Data)

Season Ending	Acreage	Crop (Thousands of Pounds)	Season Ending	Acreage	Crop (Thousands of Pounds)
1916	1,722	631,840	1908	1,706	668,687
1915	1,233	472,964	1907	1,667	716,627
1914	1,825	638,972	1906	1,566	688,298
1913	1,792	759,119	1905	1,630	590,338
1912	1,791	742,776	1904	1,494	625,303
1911	1,779	731,583	1903	1,386	644,716
1910	1,709	743,370	1902	1,327	578,353
1909	1,661	495,349			

TOTAL IMPORTS OF COTTON, BY COUNTRIES OF PRODUCTION: 1913–1917

(Equivalent 500-pound bales. Bureau of Foreign and Domestic Commerce)

Produced in	Imports for Year Ending July 31			
	1917	1916	1915	1914
Total	291,957	437,574	382,286	260,988
Egypt	199,892	350,796	252,373	138,579
China	36,063	35,792	25,031	20,772
Peru	11,069	10,909	10,353	12,627
India	3,860	4,214	7,845	7,849
Mexico	32,858	30,098	85,180	80,285
All other	8,215	5,765	904	876

ACREAGE OF COTTON IN THE UNITED STATES, BY STATES: 1908–1917

(United States Census Data)

State	Thousands of Acres									
	1917*	1916	1915	1914	1913	1912	1911	1910	1909	1908
Total	33,634	35,985	31,412	36,832	37,089	34,283	36,045	32,403	32,044	32,444
Alabama	2,195	3,225	3,340	4,007	3,760	3,730	4,017	3,560	3,731	3,591
Arkansas	2,645	2,600	2,170	2,480	2,502	1,991	2,363	2,238	2,153	2,296
Florida	183	191	193	221	188	224	308	257	263	265
Georgia	5,028	5,277	4,825	5,433	5,318	5,335	5,504	4,873	4,883	4,848
Louisiana	1,350	1,250	990	1,299	1,244	929	1,075	975	957	1,550
Mississippi	2,801	3,110	2,735	3,054	3,067	2,889	3,340	3,317	3,400	3,395
Missouri †	221	210	150	212	126	112	141	109	106	87
North Carolina	1,453	1,451	1,282	1,527	1,576	1,545	1,624	1,478	1,274	1,458
Oklahoma	2,838	2,562	1,895	2,847	3,009	2,665	3,050	2,204	1,977	2,311
South Carolina	2,876	2,780	2,516	2,861	2,790	2,695	2,800	2,534	2,557	2,545
Tennessee	857	887	772	915	865	783	837	765	788	754
Texas	11,052	11,400	10,510	11,931	12,597	11,338	10,943	10,060	9,930	9,316
Virginia	45	42	34	45	47	47	43	33	25	28

* December estimate of United States Department of Agriculture.
† Includes statistics for other states not named.

COTTON STOCKS, EXCLUSIVE OF LINTERS, HELD AT MILLS, AND ELSEWHERE, AT THE CLOSE OF THE SEASON: 1913–1917

(Running bales, counting round as half bales. United States Census Data)

Season Ending	Stocks in Mills					In Public Warehouses or at Compresses
	Total	Domestic	Foreign	In Cotton-growing States	In All Other States	
1917	1,501,916	1,407,605	94,311	609,090	892,826	888,257
1916	1,632,245	1,489,727	142,518	684,654	947,591	1,107,464
1915	1,401,185	611,724	108,782	577,201	823,984	1,784,919
1914	675,873	637,725	64,149	326,953	578,809	425,102
1913	717,704	733,248	79,979	345,152	612,409	381,739

STOCKS OF LINTERS, HELD AT MILLS, AND IN PUBLIC STORAGE OR AT COMPRESSES AT THE CLOSE OF THE SEASON: 1913–1917

(In running bales, counting round as half bales. United States Census Data)

Season Ending	Stocks in Mills			In Public Storage or at Compresses
	Total	In Cotton-growing States	In All Other States	
1917	112,972	14,574	98,398*	230,687
1916	100,441	33,463	66,978	113,106
1915	198,905	96,530	102,375	89,881
1914	75,346	20,711	63,507	32,366
1913	60,454	17,815	54,578	29,148

* Includes Mississippi.

PRODUCTION, CONSUMPTION, AND EXPORTS OF SEA-ISLAND COTTON: 1903–1917

(Commercial and Financial Chronicle Data)

Year ending August 31	Production				American Consumption	Exports	
	Total	Florida	Georgia	So. Carolina		Total	Gt. Britain
1917*	114,081	43,080	67,506	3,495	113,372	2,173	1,478
1916*	84,521	30,367	47,943	6,211	80,032	4,363	2,624
1915*	77,812†	35,686	36,630	5,488	73,313	5,846	1,711
1914*	83,857	34,000	39,384	10,473	77,374	17,646	12,359
1913	68,163	20,780	39,008	8,375	44,862	13,195	8,528
1912	122,866	60,902	56,824	5,140	95,588	27,483	19,667
1911	89,601	35,190	41,073	13,338	62,825	22,925	16,505
1910	96,539	39,261	42,781	14,497	67,562	20,428	24,744
1909	102,469	42,186	45,171	15,172	77,544	25,808	18,241
1908	85,191	41,863	30,590	12,738	50,300	32,383	22,748
1907	56,108	23,411	24,653	8,044	36,101	20,489	15,200
1906	116,962	30,378	72,872	13,712	78,923	39,262	30,034
1905	99,663	37,873	49,696	12,094	62,556	38,402	30,832
1904	76,709	28,005	39,345	9,359	43,578	31,320	24,188
1903	102,634	27,686	62,451	12,497	50,524	54,082	44,354

* Year ending July 31.

† Includes 8 bales grown in Texas.

COTTON CONSUMED IN THE UNITED STATES: 1906–1917

Running bales, except foreign cotton which are in equivalent 500-pound bales.
(United States Census Data)

Year	Cotton Consumed (Bales)						
	United States	Domestic	Foreign	Linters	Cotton-growing States	New England States	All Other States
1917 . .	7,658,207	6,470,244	318,261	869,702	4,335,007	2,654,138	669,062
1916 . .	7,278,529	6,080,618	316,995	880,916	3,977,130	2,627,150	674,249
1915 . .	6,009,207	5,375,305	222,057	411,845	3,193,353	2,197,220	618,634
1914 . .	5,884,733	5,383,099	194,309	307,325	3,023,415	2,251,041	610,277
1913 . .	5,786,330	5,250,392	232,929	303,009	2,960,518	2,210,813	614,999
1912 . .	5,367,583	4,921,683	207,663	238,237	2,712,223	2,108,360	547,000
1911 . .	4,704,978	4,322,987	175,430	206,561	2,328,487	1,911,092	465,399
1910 . .	4,798,953	4,465,968	155,774	177,211	2,292,333	2,016,386	490,234
1909 . .	5,240,719	4,929,796	161,738	149,185	2,553,797	2,144,448	542,474
1908 . .	4,539,090	4,389,642	149,628	(*)	2,187,096	1,894,835	457,159
1907 . .	4,984,936	4,844,568	140,368	(*)	2,410,993	2,073,355	500,588
1906 . .	4,909,279	4,470,804	138,475	(*)	2,373,577	2,059,900	475,802

*Linters consumed included under "Domestic." Separate statistics not available.

WORLD'S CONSUMPTION OF COTTON: 1913–1917

(Commercial and Financial Chronicle Estimates)

Country	500-Pound Bales consumed for Year ending July 31				
	1917	1916	1915	1914	1913*
United States—North .	3,193,392	3,238,748	2,768,415	2,701,479	2,681,804
United States—South	4,237,296	3,870,971	3,037,280	2,978,533	2,849,524
Total United States .	7,430,688	7,109,719	5,805,695	5,680,012	5,531,328
Great Britain	3,000,000	4,000,000	3,900,000	4,300,000	4,400,000
Continent	4,000,000	4,500,000	5,000,000	6,000,000	6,000,000
East Indies	1,764,000	1,660,000	1,648,468	1,680,210	1,642,287
Japan	1,850,000	1,540,000	1,526,677	1,521,582	1,351,709
Other countries . . .	1,195,915	763,640	854,296	676,372	618,683
World Total	19,240,603	19,573,359	18,735,136	19,858,176	19,544,007

* Year ending August 31.

NEW YORK COTTON EXCHANGE PRICES, PER POUND, FOR "SPOT" MIDDLINGS UPLAND

HIGHEST AND LOWEST: 1893–1917

Season Ending	High	Low	Season Ending	High	Low
	Cents	*Cents*		*Cents*	*Cents*
1917	27.65	13.35	1904	17.25	9.50
1916	13.45	9.20	1903	13.50	8.30
1915	10.60	7.25	1902	$9\frac{7}{8}$	$7\frac{13}{16}$
1914	14.50	11.90	1901	12	$8\frac{1}{4}$
1913	13.40	10.75	1900	$10\frac{1}{4}$	$6\frac{1}{4}$
1912	13.40	9.20	1899	$6\frac{5}{8}$	$5\frac{5}{16}$
1911	19.75	12.30	1898	$8\frac{1}{4}$	$5\frac{13}{16}$
1910	16.45	12.40	1897	$8\frac{7}{8}$	$7\frac{1}{16}$
1909	13.15	9.00	1896	$9\frac{3}{8}$	$7\frac{1}{16}$
1908	13.55	9.90	1895	$7\frac{3}{8}$	$5\frac{9}{16}$
1907	13.50	9.60	1894	$8\frac{9}{16}$	$6\frac{1}{16}$
1906	12.60	9.85	1893	10	$7\frac{1}{16}$
1905	11.65	6.85			

MONTHLY PRICES OF COTTON

Average price, cents per pound, to producers of cotton, monthly, 1908–1917. Estimates of United States Department of Agriculture.

	1917	1916	1915	1914	1913	1912	1911	1910	1909	1908
January 1	17.1	11.4	6.6	11.7	12.2	8.4	14.4	14.6	8.4	10.7
February 1	16.8	11.5	7.4	11.9	11.9	9.0	14.3	14.0	9.0	10.8
March 1	15.9	11.1	7.4	12.6	11.8	9.8	13.9	14.0	9.0	11.0
April 1	18.0	11.5	8.1	11.9	11.8	10.1	13.9	14.1	9.1	10.2
May 1	18.9	11.5	9.1	12.2	11.6	10.9	14.2	14.0	9.6	9.6
June 1	20.2	12.2	8.6	12.4	11.5	11.0	14.6	14.2	10.1	10.6
July 1	24.7	12.5	8.6	12.4	11.6	11.2	14.4	13.9	10.3	10.9
August 1	24.3	12.6	8.1	12.4	11.5	12.0	13.2	14.3	11.3	10.3
September 1	23.4	14.6	8.5	8.7	11.8	11.3	11.8	14.4	11.7	9.4
October 1	23.3	15.5	11.2	7.8	13.3	11.2	10.2	13.3	12.6	9.0
November 1	27.3	18.0	11.6	6.3	13.0	10.9	8.9	14.0	13.7	8.7
December 1	27.7	19.6	11.3	6.8	12.3	11.9	8.8	14.1	13.9	8.7

ACREAGE, CONDITION, CROP AND PRICE OF RAW COTTON: 1893-1917

(United States Census and United States Department of Agriculture Data)

Season Ending	Acreage (Thousands of Acres)	Crop Condition				Crop (Thousands of Running Bales)	Average Net Weight of Bale (Pounds)	Average Price Per Pound, Upland Cotton (Cents)
		June	July	Aug.	Sept.			
1917	34,600	77.5	81.1	72.3	61.2	11,286[1]		
1916	34,985	80.0	80.3	75.3	69.2	11,364	482	17.3
1915	31,412	74.3	79.6	76.4	78.0	11,068	484	11.2
1914	36,832	79.1	81.8	79.6	68.2	15,906	485	7.3
1913	37,089	78.9	80.4	76.5	74.8	13,983	484	12.5
1912	34,283	87.8	88.2	89.1	73.2	13,489	486	11.5
1911	36,045	82.0	80.7	75.5	72.1	15,553	483	9.6
1910	32,403	81.1	74.6	71.9	63.7	11,568	480	14.0
1909	32,044	79.7	81.2	83.0	76.1	10,073	475	14.3
1908	32,444	70.5	72.0	75.0	72.7	13,086	484	9.2
1907	31,311	84.6	83.3	82.9	77.3	11,058	480	11.5
1906	31,374	77.2	77.0	74.9	72.1	12,983	489	10.0
1905	26,117	83.0	88.0	91.6	84.1	10,495	482	10.9
1904	30,054	74.1	77.1	79.7	81.2	13,451	478	8.7
1903	28,017	95.1	84.7	81.9	64.0	9,820	480	12.2
1902	27,114	81.5	81.1	77.2	71.4	10,588	481	8.2
1901	27,220	82.5	75.8	76.0	68.2	9,583	489	8.1
1900	25,758	85.7	87.8	84.0	68.5	10,102	480	9.3
1899	24,275	89.0	91.2	91.2	79.8	9,393	476	7.6
1898	24,967	83.5	86.0	86.9	78.3	11,189	489	4.9
1897	24,320	97.2	92.5	80.1	64.2	10,898	482	5.6
1896	23,273	81.0	82.3	77.9	70.8	8,533	477	7.3
1895	20,185	88.3	89.6	91.8	85.9	7,161	477	8.2
1894	23,688	85.6	82.7	80.4	73.4	9,901	484	5.9
1893	19,525	85.9	86.9	82.3	76.8	7,493	474	7.5

[1] Equivalent 500-pound bales.

ESTIMATED VALUES OF COTTON AND COTTON SEED PRODUCED AND OF COTTON EXPORTED

(U. S. Census Data)

Year ending July 31	Value of Cotton Produced	Value of Cotton Seed Produced	Total Value of Cotton Crop	Value of Cotton Exported
1903	$421,688,000	$80,209,000	$501,897,000	$316,180,429
1904	576,500,000	84,050,000	660,550,000	370,811,246
1905	561,100,000	90,930,000	652,030,000	379,965,014
1906	556,830,000	75,470,000	632,300,000	401,005,921
1907	640,310,000	81,340,000	721,650,000	481,277,797
1908	613,630,000	87,330,000	700,960,000	437,788,202
1909	588,810,000	92,420,000	681,230,000	417,390,655
1910	688,350,000	123,740,000	812,090,000	450,447,243
1911	820,320,000	142,860,000	963,180,000	585,318,869
1912	749,890,000	119,800,000	869,690,000	565,849,271
1913	786,800,000	117,330,000	904,130,000	547,357,195
1914	885,350,000	141,350,000	1,026,700,000	610,475,301
1915	591,130,000	128,950,000	720,080,000	376,217,972
1916	627,940,000	167,900,000	795,840,000	374,186,247
1917	975,000,000	252,000,000	1,227,000,000	545,537,000

RANGE OF KILLING FROST DATES IN COTTON GROWING STATES: 1914-1916

(United States Department of Agriculture Data)

	1916		1915		1914	
Alabama	Oct. 20	Nov. 17	Oct. 9	Nov. 16	Oct. 27	Nov. 20
Arkansas	Sept. 30	" 15	" 8	" 15	" 27	" 17
Florida	Oct. 22	Dec. 19	Nov. 16	Dec. 22	" 27	" 21
Georgia	" 22	Nov. 16	" 4	Nov. 30	" 28	" 20
Louisiana	" 21	" 17	Oct. 10	Dec. 8	" 27	Dec. 15
Mississippi	" 21	" 15	" 10	" 21	" 28	Nov. 20
Missouri	Sept. 15	" 14	" 5	Nov. 15	" 27	Oct. 28
North Carolina	Oct. 1	" 17	Sept. 23	Dec. 22	" 17	Dec. 15
Oklahoma	Sept. 29	Oct. 21	Oct. 6	Nov. 15	" 14	Nov. 17
South Carolina	Oct. 21	Nov. 16	" 10	Dec. 14	" 28	" 21
Tennessee	Sept. 30	" 14	" 8	Nov. 16	" 27	" 17
Texas	Oct. 19	Dec. 15	" 6	Dec. 29	" 13	Dec. 31
Virginia	Sept. 19	Nov. 17	" 8	Nov. 17	" 27	Nov. 21

In connection with the above table it should be stated that, broadly speaking, the dates in the second columns are those which are important from an agricultural standpoint. In most instances the first column records a frost experienced only in the highest altitudes of the section.

COTTON SPINDLES IN THE WORLD ACCORDING TO LATEST KNOWN ESTIMATES

(Annual Cotton Handbook)

Country	Year	Spindles	Country	Year	Spindles
United States—North	1916	19,597,871	China	1917	1,126,568
United States—South	1917	13,937,167	Japan	1917	3,181,064
Great Britain	1917	60,973,381	Indo-China	1917	700,000
Canada	1917	1,367,941	Philippines	1916	7,440
Germany	1914	10,162,872	Brazil	1913	1,520,000
Russia	1917	9,576,952	Argentina	1914	9,000
France	1914	7,400,000	Chile	1916	5,000
Austria-Hungary	1914	4,941,320	Peru	1917	67,900
Switzerland	1917	1,454,494	Venezuela	1915	19,000
Italy	1917	4,600,000	Colombia	1914	20,000
Spain	1917	2,250,000	Ecuador	1911	5,000
Portugal	1917	428,000	Guatemala	1911	8,000
Belgium	1914	1,775,000	Mexico	1913	762,149
Holland	1914	606,646	Total (estimated)		154,310,563
Sweden	1917	573,018	Estimate in "Cotton Facts"		151,200,000
Other European Countries	–	333,363	Estimate of Commercial and Financial Chronicle		146,352,825
Egypt	1914	20,000			
Asia Minor	1914	41,000			
India	1916	6,839,877	U. S. Census estimate	1914	146,397,000

TOTAL NUMBER OF COTTON SPINDLES, AND NUMBER ACTIVE, BY SECTIONS: 1907–1918

(United States Census Data)

Season Ending	Total Spindles	Active Cotton Spindles			
		United States	Cotton-growing States	New England States.	All Other States.
1917	34,221,252	33,888,835	14,155,758	17,760,968	1,972,109
1916	33,333,176	32,805,883	13,382,065	17,474,264	1,949,554
1915	32,840,730	31,964,235	12,955,712	17,100,615	1,907,908
1914	32,744,012	32,107,572	12,711,303	17,408,372	1,987,897
1913	32,149,617	31,519,766	12,227,226	17,311,451	1,981,089
1912	31,582,679	30,578,528	11,582,869	17,139,945	1,855,714
1911	30,803,662	29,522,597	11,084,623	16,510,981	1,926,993
1910	28,929,093	28,266,862	10,494,112	15,735,086	2,037,664
1909	28,573,435	28,018,305	10,429,200	15,591,851	1,997,254
1908	27,964,387	27,505,422	10,200,903	15,329,333	1,975,186

AVERAGE WEEKLY PRICES OF 27 IN., 64 x 60, 7.60 YD. PRINTING CLOTHS

Quotations furnished by Messrs. J. M. Prendergast & Co., Boston.

Week Ending*		1917	1916	1915	1914
January	6	5 3/8	3 3/8	2 7/16	
	13	5 1/2	3 3/8	2 1/2	3 5/16
	20	5 3/8	3 1/2	2 5/8	3 3/8
	27	5 3/8	3 1/2	2 11/16	3 3/8
February	3	5 1/4	3 1/2	2 11/16	3 3/8
	10	5	3 7/16	2 5/8	3 5/16
	17	5	3 7/16	2 5/8	3 5/16
	24	5 1/8	3 1/2	2 9/16	3 5/16
March	3	4 3/4	3 7/16	2 5/8	3 5/16
	10	5	3 1/2	2 5/8	3 1/4
	17	5	3 5/8	2 5/8	3 1/4
	24	5 1/4	3 5/8	2 11/16	3 1/4
	31	5 1/2	3 5/8	2 11/16	3 1/4
April	7	5 1/2	3 3/4	2 3/4	3 5/16
	14	5 5/8	3 3/4	2 7/8	3 5/16
	21	5 3/4	3 7/8	3	3 1/4
	28	5 3/4	3 7/8	3 1/16	3 1/4
May	5	5 7/8	3 7/8	3	3 3/16
	12	5 7/8	3 15/16	3	3 3/16
	19	6 1/8	3 15/16	3	3 1/4
	26	6 1/4	3 15/16	2 15/16	3 5/16
June	2	6 1/2	3 15/16	2 31/32	3 5/16
	9	6 3/4	3 7/8	2 15/16	3 5/16
	16	7	3 7/8	2 7/8	3 5/16
	23	7 1/8	3 3/4	2 7/8	3 5/16
	30	7 1/4	3 13/16	2 7/8	3 5/16

Week Ending*		1917	1916	1915	1914
July	7	7 1/4	3 7/8	2 7/8	3 5/16
	14	7 1/4	3 7/8	2 13/16	3 1/4
	21	7 1/4	3 7/8	2 13/16	3 1/4
	28	7 1/4	3 7/8	2 3/4	3 1/4
August	4	7 1/8	4C	2 11/16	3 3/16
	11	7 1/8	4C	2 11/16	3 1/8
	18	7 1/8	4C	2 11/16	3 1/8
	25	7 1/8	4 1/8	2 11/16	3 1/8
September	1	6 7/8	4 3/8	2 3/4	2 7/8
	8	6 7/8	4 1/2	2 13/16	2 7/8
	15	6 3/4	4 1/2	2 7/8	2 7/8
	22	6 7/8	4 1/2	3	2 7/8
	29	7	4 1/2	3 1/4	2 5/8
October	6	7 1/8	4 3/4	3 1/4	2 1/2
	13	7 3/8	4 7/8	3 1/4	2 1/2
	20	7 1/2	5 1/8	3 1/4	2 1/2
	27	7 3/4	5 1/4	3 1/4	2 1/2
November	3	7 7/8	5 1/2	3 1/8	2 5/8
	10	7 7/8	5 1/2	3 1/8	2 1/2
	17	8	5 1/2	3 1/8	2 1/2
	24	8 1/4	5 1/2	3 1/8	2 1/2
December	1	8 1/2	5 5/8	3 1/8	2 7/16
	8	8 1/2	5 5/8	3 1/8	2 7/16
	15	8 1/2	5 3/8	3 1/4	2 7/16
	22	8 1/2	5 1/4	3 1/4	2 7/16
	29	8 1/2	5 1/4	3 1/4	2 7/16

* The dates refer to 1917, for previous years the figures refer to the corresponding week.

WEEKLY SALES OF PRINT CLOTHS AT FALL RIVER

(In thousands of Pieces)

Data supplied by Messrs. J. M. Prendergast & Co., Boston.

Date[1]	1917	1916	1915	1914	1913
January 6	50	160	175	203	116
13	65	215	260	192	89
20	65	175	350	100	127
27	120	150	140	130	360
February 3	70	150	110	92	162
10	80	150	90	146	60
17	170	250	60	100	172
24	225	200	60	110	138
March 3	180	200	70	150	102
10	300	250	100	90	71
17	350	300	140	140	59
24	380	300	360	270	73
31	400	180	275	180	118
April 7	278	160	160	90	138
14	350	150	300	60	70
21	160	160	250	60	68
28	150	160	100	70	90
May 5	160	200	135	110	176
12	140	150	75	100	148
19	180	90	50	280	260
26	230	120	125	250	211
June 2	190	60	90	220	122
9	200	85	90	140	130
16	230	70	80	75	80
23	140	90	110	60	142
30	130	175	130	70	120
July 7	100	100	100	146	170
14	100	170	110	146	110
21	100	120	140	60	105
28	50	160	161	70	150
August 4	120	250	150	30	113
11	200	400	110	50	119
18	100	300	100	75	238
25	100	300	115	70	243
September 1	80	220	300	60	225
8	60	120	175	50	261
15	80	150	200	120	240
22	120	220	225	150	240
29	270	280	150	110	150
October 6	260	280	140	70	150
13	220	175	150	80	62
20	180	250	110	110	120
27	210	260	130	280	110
November 3	230	140	100	260	75
10	220	125	100	130	75
17	290	165	130	140	75
24	300	180	160	90	70
December 1	200	120	210	80	175
8	200	125	220	100	95
15	160	90	141	200	57
22	140	70	200	131	71
29	130	50	200	90	142

[1] Dates refer to 1917, other years are for corresponding weeks.

ROVING TABLE

For numbering by the weight, in grains, of 12 yds.; and showing twist per inch.

Grains Weight	Hank Roving	Sq. Root	Twist Per In.	Grains Weight	Hank Roving	Sq. Root	Twist Per In.	Grains Weight	Hank Roving	Sq. Root	Twist Per In.
400.00	.25	.500	.60	147.06	.68	.825	.99	81.07	1.22	1.105	1.33
384.61	.26	.510	.61	144.93	.69	.831	1.00	80.65	1.24	1.114	1.34
370.37	.27	.520	.62	142.86	.70	.837	1.00	79.37	1.26	1.122	1.35
357.14	.28	.529	.63	140.85	.71	.843	1.01	78.12	1.28	1.131	1.36
344.83	.29	.539	.65	138.89	.72	.849	1.02	76.92	1.30	1.140	1.37
333.33	.30	.548	.66	135.99	.73	.854	1.02	75.76	1.32	1.149	1.38
322.58	.31	.557	.67	135.14	.74	.860	1.03	74.63	1.34	1.158	1.39
312.50	.32	.566	.68	133.33	.75	.866	1.04	75.53	1.36	1.166	1.40
303.03	.33	.574	.69	131.58	.76	.872	1.05	72.46	1.38	1.175	1.41
294.12	.34	.583	.70	129.87	.77	.874	1.05	71.43	1.40	1.183	1.42
285.71	.35	.592	.71	128.21	.78	.883	1.06	70.42	1.42	1.192	1.43
277.78	.36	.600	.72	126.58	.79	.889	1.07	69.44	1.44	1.200	1.44
270.27	.37	.608	.73	125.00	.80	.894	1.07	68.49	1.46	1.208	1.45
263.16	.38	.616	.74	123.46	.81	.900	1.08	67.57	1.48	1.217	1.46
256.41	.39	.624	.75	121.95	.82	.906	1.09	66.67	1.50	1.225	1.47
250.00	.40	.632	.76	120.48	.83	.911	1.09	65.79	1.52	1.233	1.48
243.90	.41	.640	.77	119.05	.84	.917	1.10	64.04	1.54	1.241	1.49
238.10	.42	.648	.78	117.65	.85	.922	1.11	64.10	1.56	1.249	1.50
232.56	.43	.656	.79	116.28	.86	.927	1.11	63.29	1.58	1.257	1.51
227.27	.44	.663	.80	114.94	.87	.933	1.12	62.50	1.60	1.265	1.52
222.22	.45	.671	.80	113.64	.88	.938	1.13	61.73	1.62	1.273	1.53
217.39	.46	.678	.81	112.36	.89	.943	1.13	60.98	1.64	1.281	1.54
212.77	.47	.686	.82	111.11	.90	.949	1.14	60.24	1.66	1.288	1.55
208.33	.48	.693	.83	109.89	.91	.954	1.14	59.52	1.68	1.296	1.56
204.08	.49	.700	.84	108.70	.92	.959	1.15	58.82	1.70	1.304	1.56
200.00	.50	.707	.85	107.53	.93	.964	1.16	58.14	1.72	1.311	1.57
196.08	.51	.714	.86	106.38	.94	.970	1.16	57.47	1.74	1.319	1.58
192.31	.52	.721	.87	105.26	.95	.975	1.17	56.82	1.76	1.327	1.59
188.68	.53	.728	.87	104.17	.96	.980	1.18	56.18	1.78	1.334	1.60
185.19	.54	.735	.88	103.09	.97	.985	1.18	55.56	1.80	1.342	1.61
181.82	.55	.742	.89	102.04	.98	.990	1.19	54.95	1.82	1.349	1.62
178.57	.56	.748	.90	101.01	.99	.995	1.19	54.35	1.84	1.356	1.63
175.44	.57	.755	.91	100.00	1.00	1.000	1.20	53.76	1.86	1.364	1.64
172.41	.58	.762	.91	98.04	1.02	1.010	1.21	53.19	1.88	1.371	1.65
169.49	.59	.768	.92	96.15	1.04	1.020	1.22	52.63	1.90	1.378	1.65
166.67	.60	.775	.93	94.34	1.06	1.030	1.24	52.08	1.92	1.386	1.66
163.93	.61	.781	.94	92.59	1.08	1.039	1.25	51.55	1.94	1.393	1.67
161.29	.62	.787	.94	90.91	1.10	1.049	1.26	51.02	1.96	1.400	1.68
158.73	.63	.794	.95	89.29	1.12	1.058	1.27	50.51	1.98	1.407	1.69
156.25	.64	.800	.96	87.72	1.14	1.068	1.28	50.00	2.00	1.414	1.70
153.85	.65	.806	.97	86.21	1.16	1.077	1.29	49.50	2.02	1.421	1.71
151.52	.66	.812	.97	84.75	1.18	1.086	1.30	49.02	2.04	1.428	1.71
149.25	.67	.819	.98	83.33	1.20	1.095	1.31	48.54	2.06	1.435	1.72

ROVING TABLE (continued)

For numbering by the weight, in grains, of 12 yds.; and showing twist per inch.

Grains Weight	Hank Roving	Sq. Root	Twist Per In.	Grains Weight	Hank Roving	Sq. Root	Twist Per In.	Grains Weight	Hank Roving	Sq. Root	Twist Per In.
48.08	2.08	1.442	1.73	34.01	2.94	1.715	2.06	14.29	7.00	2.646	3.17
47.62	2.10	1.449	1.74	33.78	2.96	1.721	2.07	14.08	7.10	2.665	3.20
47.17	2.12	1.456	1.75	33.56	2.98	1.726	2.07	13.89	7.20	2.683	3.22
46.73	2.14	1.463	1.76	33.33	3.00	1.732	2.08	13.70	7.30	2.702	3.24
46.30	2.16	1.470	1.76	32.26	3.10	1.761	2.11	13.51	7.40	2.720	3.26
45.87	2.18	1.476	1.77	31.25	3.20	1.789	2.15	13.33	7.50	2.739	3.29
45.45	2.20	1.483	1.78	30.30	3.30	1.817	2.18	13.16	7.60	2.757	3.31
45.05	2.22	1.490	1.79	29.41	3.40	1.844	2.21	12.99	7.70	2.775	3.33
44.64	2.24	1.497	1.80	28.57	3.50	1.871	2.24	12.82	7.80	2.793	3.35
44.25	2.26	1.503	1.80	27.78	3.60	1.897	2.28	12.66	7.90	2.811	3.37
43.86	2.28	1.510	1.81	27.03	3.70	1.924	2.31	12.50	8.00	2.828	3.39
43.48	2.30	1.517	1.82	26.32	3.80	1.949	2.34	12.35	8.10	2.846	3.42
43.10	2.32	1.523	1.83	25.64	3.90	1.975	2.37	12.20	8.20	2.864	3.44
42.74	2.34	1.530	1.84	25.00	4.00	2.000	2.40	12.05	8.30	2.881	3.46
42.37	2.36	1.536	1.84	24.39	4.10	2.025	2.43	11.90	8.40	2.898	3.48
42.02	2.38	1.543	1.85	23.81	4.20	2.049	2.46	11.76	8.50	2.915	3.50
41.67	2.40	1.549	1.86	23.26	4.30	2.074	2.49	11.63	8.60	2.933	3.52
41.32	2.42	1.556	1.87	22.73	4.40	2.098	2.52	11.49	8.70	2.950	3.54
40.98	2.44	1.562	1.87	22.22	4.50	2.121	2.55	11.36	8.80	2.966	3.56
40.65	2.45	1.568	1.88	21.74	4.60	2.145	2.57	11.24	8.90	2.983	3.58
40.32	2.48	1.575	1.89	21.28	4.70	2.168	2.60	11.11	9.00	3.000	3.60
40.00	2.50	1.581	1.90	20.83	4.80	2.191	2.63	10.99	9.10	3.017	3.62
39.68	2.52	1.587	1.90	20.41	4.90	2.214	2.66	10.87	9.20	3.033	3.64
39.37	2.54	1.594	1.91	20.00	5.00	2.236	2.68	10.75	9.30	3.050	3.66
39.06	2.56	1.600	1.92	19.61	5.10	2.258	2.71	10.64	9.40	3.066	3.68
38.76	2.58	1.606	1.93	19.23	5.20	2.280	2.74	10.53	9.50	3.082	3.70
38.46	2.60	1.612	1.93	18.87	5.30	2.302	2.76	10.42	9.60	3.098	3.72
38.17	2.62	1.619	1.94	18.52	5.40	2.324	2.76	10.31	9.70	3.114	3.74
37.88	2.64	1.625	1.95	18.18	5.50	2.345	2.81	10.20	9.80	3.130	3.76
37.59	2.66	1.631	1.96	17.86	5.60	2.366	2.84	10.10	9.90	3.146	3.78
37.31	2.68	1.637	1.96	17.54	5.70	2.387	2.86	10.00	10.00	3.162	3.79
37.04	2.70	1.643	1.97	17.24	5.80	2.408	2.89	9.09	11.00	3.317	3.98
36.76	2.72	1.649	1.98	16.95	5.90	2.429	2.91	8.33	12.00	3.464	4.16
36.50	2.74	1.655	1.99	16.67	6.00	2.449	2.94	7.69	13.00	3.606	4.33
36.23	2.76	1.661	1.99	16.39	6.10	2.470	2.96	7.14	14.00	3.742	4.49
35.97	2.78	1.667	2.00	16.13	6.20	2.490	2.99	6.67	15.00	3.873	4.65
35.71	2.80	1.673	2.01	15.87	6.30	2.510	3.01	6.25	16.00	4.000	4.80
35.46	2.82	1.679	2.01	15.62	6.40	2.530	3.04	5.88	17.00	4.123	4.95
35.21	2.84	1.685	2.02	15.38	6.50	2.550	3.06	5.56	18.00	4.243	5.09
34.97	2.86	1.691	2.03	15.15	6.60	2.569	3.08	5.26	19.00	4.359	5.23
34.72	2.88	1.697	2.04	14.93	6.70	2.588	3.11	5.00	20.00	4.472	5.37
34.48	2.90	1.703	2.04	14.71	6.80	2.608	3.13				
34.25	2.92	1.709	2.05	14.49	6.90	2.627	3.15				

YARN TABLE

For numbering Cotton Yarn by the weight in grains of 120 yards or 1 skein.

120 Yds. Weigh Grs.	Number of Yarn	120 Yds. Weigh Grs.	Number of Yarn	120 Yds. Weigh Grs.	Number of Yarn	120 Yds. Weigh Grs.	Number of Yarn	120 Yds. Weigh Grs.	Number of Yarn	120 Yds. Weigh Grs.	Number of Yarn	120 Yds. Weigh Grs.	Number of Yarn	120 Yds. Weigh Grs.	Number of Yarn
1.	1000.	13.	76.92	19.	52.63	25.	40.00	31.	32.26	37.	27.03	43.	23.26	49.	20.41
2.	500.	.1	76.34	.1	52.36	.1	39.84	.1	32.16	.1	26.95	.1	23.20	.1	20.37
3.	333.3	.2	75.76	.2	52.08	.2	39.68	.2	32.05	.2	26.88	.2	23.15	.2	20.33
4.	250.0	.3	75.19	.3	51.81	.3	39.53	.3	31.95	.3	26.81	.3	23.09	.3	20.28
5.	200.0	.4	74.63	.4	51.55	.4	39.37	.4	31.85	.4	26.74	.4	23.04	.4	20.24
5.5	181.8	.5	74.07	.5	51.28	.5	39.22	.5	31.75	.5	26.67	.5	22.99	.5	20.20
6.	166.7	.6	73.53	.6	51.02	.6	39.06	.6	31.65	.6	26.60	.6	22.94	.6	20.16
6.5	153.8	.7	72.99	.7	50.76	.7	38.91	.7	31.55	.7	26.53	.7	22.88	.7	20.12
7.	142.9	.8	72.46	.8	50.51	.8	38.76	.8	31.45	.8	26.46	.8	22.83	.8	20.08
7.5	133.3	.9	71.94	.9	50.25	.9	38.61	.9	31.35	.9	26.39	.9	22.78	.9	20.04
8.	125.0	14.	71.43	20.	50.00	26.	38.46	32.	31.25	38.	26.32	44.	22.73	50.	20.00
.1	123.5	.1	70.92	.1	49.75	.1	38.31	.1	31.15	.1	26.25	.1	22.68	.1	19.96
.2	122.0	.2	70.42	.2	49.50	.2	38.17	.2	31.06	.2	26.18	.2	22.62	.2	19.92
.3	120.5	.3	69.93	.3	49.26	.3	38.02	.3	30.96	.3	26.11	.3	22.57	.3	19.88
.4	119.0	.4	69.44	.4	49.02	.4	37.88	.4	30.86	.4	26.04	.4	22.52	.4	19.84
.5	117.6	.5	68.97	.5	48.78	.5	37.74	.5	30.77	.5	25.97	.5	22.47	.5	19.80
.6	116.3	.6	68.49	.6	48.54	.6	37.59	.6	30.67	.6	25.91	.6	22.42	.6	19.76
.7	114.9	.7	68.03	.7	48.31	.7	37.45	.7	30.58	.7	25.84	.7	22.37	.7	19.72
.8	113.6	.8	67.57	.8	48.08	.8	37.31	.8	30.49	.8	25.77	.8	22.32	.8	19.69
.9	112.4	.9	67.11	.9	47.85	.9	37.17	.9	30.40	.9	25.71	.9	22.27	.9	19.65
9.	111.1	15.	66.67	21.	47.62	27.	37.04	33.	30.30	39.	25.64	45.	22.22	51.	19.61
.1	109.9	.1	66.23	.1	47.33	.1	36.90	.1	30.21	.1	25.58	.1	22.17	.1	19.57
.2	108.7	.2	65.79	.2	47.17	.2	36.77	.2	30.12	.2	25.51	.2	22.12	.2	19.53
.3	107.5	.3	65.36	.3	46.95	.3	36.63	.3	30.03	.3	25.45	.3	22.08	.3	19.49
.4	106.4	.4	64.94	.4	46.73	.4	36.50	.4	29.94	.4	25.38	.4	22.03	.4	19.46
.5	105.3	.5	64.52	.5	46.51	.5	36.36	.5	29.85	.5	25.32	.5	21.98	.5	19.42
.6	104.2	.6	64.10	.6	46.30	.6	36.23	.6	29.76	.6	25.25	.6	21.93	.6	19.38
.7	103.1	.7	63.69	.7	46.08	.7	36.10	.7	29.67	.7	25.19	.7	21.88	.7	19.34
.8	102.0	.8	63.29	.8	45.87	.8	35.97	.8	29.59	.8	25.13	.8	21.83	.8	19.31
.9	101.0	.9	62.89	.9	45.66	.9	35.84	.9	29.50	.9	25.06	.9	21.79	.9	19.27

YARN TABLE (continued)

For numbering Cotton Yarn by the weight in grains of 120 yards or 1 skein.

10.	100.0	16.	62.50	22.	45.45	28.	35.71	34.	29.41	40.	25.00	46.	21.74	52.	19.23
.1	99.01	.1	62.11	.1	45.25	.1	35.59	.1	29.33	.1	24.94	.1	21.69	.1	19.19
.2	98.04	.2	61.73	.2	45.05	.2	35.46	.2	29.24	.2	24.88	.2	21.65	.2	19.16
.3	97.09	.3	61.35	.3	44.84	.3	35.34	.3	29.15	.3	24.81	.3	21.60	.3	19.12
.4	96.15	.4	60.98	.4	44.64	.4	35.21	.4	29.07	.4	24.75	.4	21.55	.4	19.08
.5	95.24	.5	60.61	.5	44.44	.5	35.09	.5	28.99	.5	24.69	.5	21.51	.5	19.05
.6	94.34	.6	60.24	.6	44.25	.6	34.97	.6	28.90	.6	24.63	.6	21.46	.6	19.01
.7	93.46	.7	59.88	.7	44.05	.7	34.84	.7	28.82	.7	24.57	.7	21.41	.7	18.98
.8	92.59	.8	59.52	.8	43.86	.8	34.72	.8	28.74	.8	24.51	.8	21.37	.8	18.94
.9	91.74	.9	59.17	.9	43.67	.9	34.60	.9	28.65	.9	24.45	.9	21.32	.9	18.90
11.	90.91	17.	58.82	23.	43.48	29.	34.48	35.	28.57	41.	24.39	47.	21.28	53.	18.87
.1	90.09	.1	58.48	.1	43.29	.1	34.36	.1	28.49	.1	24.33	.1	21.23	.1	18.83
.2	89.29	.2	58.14	.2	43.10	.2	34.25	.2	28.41	.2	24.27	.2	21.19	.2	18.80
.3	88.50	.3	57.80	.3	42.92	.3	34.13	.3	28.33	.3	24.21	.3	21.14	.3	18.76
.4	87.72	.4	57.47	.4	42.74	.4	34.01	.4	28.25	.4	24.15	.4	21.10	.4	18.73
.5	86.96	.5	57.14	.5	42.55	.5	33.90	.5	28.17	.5	24.10	.5	21.05	.5	18.69
.6	86.21	.6	56.82	.6	42.37	.6	33.78	.6	28.09	.6	24.04	.6	21.01	.6	18.66
.7	85.47	.7	56.50	.7	42.19	.7	33.67	.7	28.01	.7	23.98	.7	20.96	.7	18.62
.8	84.75	.8	56.18	.8	42.02	.8	33.56	.8	27.93	.8	23.92	.8	20.92	.8	18.59
.9	84.03	.9	55.87	.9	41.84	.9	33.44	.9	27.86	.9	23.87	.9	20.88	.9	18.55
12.	83.33	18.	55.56	24.	41.67	30.	33.33	36.	27.78	42.	23.81	48.	20.83	54.	18.52
.1	82.64	.1	55.25	.1	41.49	.1	33.22	.1	27.70	.1	23.75	.1	20.79	.1	18.48
.2	81.97	.2	54.95	.2	41.32	.2	33.11	.2	27.62	.2	23.70	.2	20.75	.2	18.45
.3	81.30	.3	54.64	.3	41.15	.3	33.00	.3	27.55	.3	23.64	.3	20.70	.3	18.42
.4	80.65	.4	54.35	.4	40.98	.4	32.89	.4	27.47	.4	23.58	.4	20.66	.4	18.38
.5	80.00	.5	54.05	.5	40.82	.5	32.79	.5	27.40	.5	23.53	.5	20.62	.5	18.35
.6	79.37	.6	53.76	.6	40.65	.6	32.68	.6	27.32	.6	23.47	.6	20.57	.6	18.32
.7	78.74	.7	53.48	.7	40.49	.7	32.57	.7	27.25	.7	23.42	.7	20.53	.7	18.28
.8	78.12	.8	53.19	.8	40.32	.8	32.47	.8	27.17	.8	23.36	.8	20.49	.8	18.25
.9	77.52	.9	52.91	.9	40.16	.9	32.36	.9	27.10	.9	23.31	.9	20.45	.9	18.21

YARN TABLE (continued)

For numbering Cotton Yarn by the weight in grains of 120 yards or 1 skein.

120 Yds. Weigh Grs.	Number of Yarn	120 Yds. Weigh Grs.	Number of Yarn	120 Yds. Weigh Grs.	Number of Yarn	120 Yds. Weigh Grs.	Number of Yarn	120 Yds. Weigh Grs.	Number of Yarn	120 Yds. Weigh Grs.	Number of Yarn	120 Yds. Weigh Grs.	Number of Yarn	120 Yds. Weigh Grs.	Number of Yarn
55.	18.18	61.	16.39	67.	14.93	73.	13.70	79.	12.66	85.	11.76	91.	10.99	97.	10.31
.1	18.15	.1	16.37	.1	14.90	.1	13.68	.1	12.64	.1	11.75	.1	10.98	.1	10.30
.2	18.12	.2	16.34	.2	14.88	.2	13.66	.2	12.63	.2	11.74	.2	10.96	.2	10.29
.3	18.08	.3	16.31	.3	14.86	.3	13.64	.3	12.61	.3	11.72	.3	10.95	.3	10.28
.4	18.05	.4	16.29	.4	14.84	.4	13.62	.4	12.59	.4	11.71	.4	10.94	.4	10.27
.5	18.02	.5	16.26	.5	14.81	.5	13.61	.5	12.58	.5	11.70	.5	10.93	.5	10.26
.6	17.99	.6	16.23	.6	14.79	.6	13.59	.6	12.56	.6	11.68	.6	10.92	.6	10.25
.7	17.95	.7	16.21	.7	14.77	.7	13.57	.7	12.55	.7	11.67	.7	10.91	.7	10.24
.8	17.92	.8	16.19	.8	14.75	.8	13.55	.8	12.53	.8	11.66	.8	10.89	.8	10.22
.9	17.89	.9	16.16	.9	14.73	.9	13.53	.9	12.52	.9	11.64	.9	10.88	.9	10.21
56.	17.86	62.	16.13	68.	14.71	74.	13.51	80.	12.50	86.	11.63	92.	10.87	98.	10.20
.1	17.83	.1	16.10	.1	14.68	.1	13.50	.1	12.48	.1	11.61	.1	10.86	.1	10.19
.2	17.79	.2	16.08	.2	14.66	.2	13.48	.2	12.47	.2	11.60	.2	10.85	.2	10.18
.3	17.76	.3	16.05	.3	14.64	.3	13.46	.3	12.45	.3	11.59	.3	10.83	.3	10.17
.4	17.73	.4	16.03	.4	14.62	.4	13.44	.4	12.44	.4	11.57	.4	10.82	.4	10.16
.5	17.70	.5	16.00	.5	14.60	.5	13.42	.5	12.42	.5	11.56	.5	10.81	.5	10.15
.6	17.67	.6	15.97	.6	14.58	.6	13.40	.6	12.41	.6	11.55	.6	10.80	.6	10.14
.7	17.64	.7	15.95	.7	14.56	.7	13.39	.7	12.39	.7	11.53	.7	10.79	.7	10.13
.8	17.61	.8	15.92	.8	14.53	.8	13.37	.8	12.38	.8	11.52	.8	10.78	.8	10.12
.9	17.57	.9	15.90	.9	14.51	.9	13.35	.9	12.36	.9	11.51	.9	10.76	.9	10.11
57.	17.54	63.	15.87	69.	14.49	75.	13.33	81.	12.35	87.	11.49	93.	10.75	99.	10.10
.1	17.51	.1	15.85	.1	14.47	.1	13.32	.1	12.33	.1	11.48	.1	10.74	.1	10.09
.2	17.48	.2	15.83	.2	14.45	.2	13.30	.2	12.32	.2	11.47	.2	10.73	.2	10.08
.3	17.45	.3	15.80	.3	14.43	.3	13.28	.3	12.30	.3	11.45	.3	10.72	.3	10.07
.4	17.42	.4	15.77	.4	14.41	.4	13.26	.4	12.29	.4	11.44	.4	10.71	.4	10.06
.5	17.39	.5	15.75	.5	14.39	.5	13.25	.5	12.27	.5	11.43	.5	10.70	.5	10.05
.6	17.36	.6	15.72	.6	14.37	.6	13.23	.6	12.25	.6	11.42	.6	10.68	.6	10.04
.7	17.33	.7	15.70	.7	14.35	.7	13.21	.7	12.24	.7	11.40	.7	10.67	.7	10.03
.8	17.30	.8	15.67	.8	14.33	.8	13.19	.8	12.22	.8	11.39	.8	10.66	.8	10.02
.9	17.27	.9	15.65	.9	14.31	.9	13.18	.9	12.21	.9	11.38	.9	10.65	.9	10.01

YARN TABLE (continued)

For numbering Cotton Yarn by the weight in grains of 120 yards or 1 skein.

58.	17.24	64.	15.62	70.	14.29	76.	13.16	82.	12.20	88.	11.36	94.	10.64	100.	10.00
.1	17.21	.1	15.60	.1	14.27	.1	13.14	.1	12.18	.1	11.35	.1	10.63	.1	9.99
.2	17.18	.2	15.58	.2	14.25	.2	13.12	.2	12.17	.2	11.34	.2	10.62	.2	9.98
.3	17.15	.3	15.55	.3	14.22	.3	13.11	.3	12.15	.3	11.33	.3	10.60	.3	9.97
.4	17.12	.4	15.53	.4	14.20	.4	13.09	.4	12.14	.4	11.31	.4	10.59	.4	9.96
.5	17.09	.5	15.50	.5	14.18	.5	13.07	.5	12.12	.5	11.30	.5	10.58	.5	9.95
.6	17.06	.6	15.48	.6	14.16	.6	13.05	.6	12.11	.6	11.29	.6	10.57	.6	9.94
.7	17.04	.7	15.46	.7	14.14	.7	13.04	.7	12.09	.7	11.27	.7	10.56	.7	9.93
.8	17.01	.8	15.43	.8	14.12	.8	13.02	.8	12.08	.8	11.26	.8	10.55	.8	9.92
.9	16.98	.9	15.41	.9	14.10	.9	13.00	.9	12.06	.9	11.25	.9	10.54	.9	9.91
59.	16.95	65.	15.38	71.	14.08	77.	12.99	83.	12.05	89.	11.24	95.	10.53	101.	9.90
.1	16.92	.1	15.36	.1	14.06	.1	12.97	.1	12.03	.1	11.22	.1	10.52	.1	9.89
.2	16.89	.2	15.34	.2	14.04	.2	12.95	.2	12.02	.2	11.21	.2	10.50	.2	9.88
.3	16.86	.3	15.31	.3	14.03	.3	12.94	.3	12.00	.3	11.20	.3	10.49	.3	9.87
.4	16.84	.4	15.29	.4	14.01	.4	12.92	.4	11.99	.4	11 19	.4	10.48	.4	9.86
.5	16.81	.5	15.27	.5	13.99	.5	12.90	.5	11.98	.5	11.17	.5	10.47	.5	9.85
.6	16.78	.6	15.24	.6	13.97	.6	12.89	.6	11.96	.6	11.16	.6	10.46	.6	9.84
.7	16.75	.7	15.22	.7	13.95	.7	12.87	.7	11.95	.7	11.15	.7	10.45	.7	9.83
.8	16.72	.8	15.20	.8	13.93	.8	12.85	.8	11.93	.8	11.14	.8	10.44	.8	9.82
.9	16.69	.9	15.17	.9	13.91	.9	12.84	.9	11.92	.9	11.12	.9	10.43	.9	9.81
60.	16.67	66.	15.15	72.	13.89	78.	12.82	84.	11.90	90.	11.11	96.	10.42	102.	9.80
.1	16.64	.1	15.13	.1	13.87	.1	12.80	.1	11.89	.1	11.10	.1	10.41	.1	9.79
.2	16.61	.2	15.11	.2	13.85	.2	12.79	.2	11.88	.2	11.09	.2	10.40	.2	9.78
.3	16.58	.3	15.08	.3	13.83	.3	12.77	.3	11.86	.3	11.07	.3	10.38	.3	9.78
.4	16.56	.4	15.06	.4	13.81	.4	12.76	.4	11.85	.4	11.06	.4	10.37	.4	9.77
.5	16.53	.5	15.04	.5	13.79	.5	12.74	.5	11.83	.5	11.05	.5	10.36	.5	9.76
.6	16.50	.6	15.02	.6	13.77	.6	12.72	.6	11.82	.6	11.04	.6	10.35	.6	9.75
.7	16.47	.7	14.99	.7	13.76	.7	12.71	.7	11.81	.7	11.03	.7	10.34	.7	9.74
.8	16.45	.8	14.97	8	13.74	.8	12.69	.8	11.79	.8	11.01	.8	10.33	.8	9.73
.9	16.42	.9	14.95	9	13.72	.9	12.67	.9	11.78	.9	11.00	.9	10.32	.9	9.72

YARN TABLE (continued)

For numbering Cotton Yarn by weight in grains of 120 yards or 1 skein.

120 Yds. Weigh Grs.	Number of Yarn	120 Yds. Weigh Grs.	Number of Yarn	120 Yds. Weigh Grs.	Number of Yarn	120 Yds. Weigh Grs.	Number of Yarn	120 Yds. Weigh Grs.	Number of Yarn	120 Yds. Weigh Grs.	Number of Yarn	120 Yds. Weigh Grs.	Number of Yarn	120 Yds. Weigh Grs.	Number of Yarn
103.	9.71	.5	9.22	119.	8.40	.5	7.02	170.	5.88	225.	4.44	310.	3.23	475.	2.11
.1	9.70	.6	9.21	.2	8.39	143.	6.99	171.	5.85	226.	4.42	212.	3.21	480.	2.08
.2	9.69	.7	9.20	.4	8.38	.5	6.97	172.	5.81	227.	4.41	314.	3.18	485.	2.06
.3	9.68	.8	9.19	.6	8.36	144.	6.94	173.	5.78	228.	4.39	316.	3.17	490.	2.04
.4	9.67	.9	9.18	.8	8.35	.5	6.92	174.	5.75	229.	4.37	318.	3.14	495.	2.02
.5	9.66	109.	9.17	120.	8.33	145.	6.90	175.	5.71	230.	4.35	320.	3.12	500.	2.00
.6	9.65	.2	9.16	.2	8.32	.5	6.87	176.	5.68	231.	4.33	322.	3.11	505.	1.98
.7	9.64	.4	9.14	.4	8.31	146.	6.85	177.	5.65	232.	4.31	324.	3.09	510.	1.96
.8	9.63	.6	9.12	.6	8.29	.5	6.83	178.	5.62	233.	4.29	326.	3.07	515.	1.94
.9	9.62	.8	9.11	.8	8.28	147.	6.80	179.	5.59	234.	4.27	328.	3.05	520.	1.92
104.	9.62	110.	9.09	121.	8.26	.5	6.78	180.	5.56	235.	4.26	330.	3.03	525.	1.90
.1	9.61	.2	9.07	.4	8.24	148.	6.76	181.	5.52	236.	4.24	332.	3.01	530.	1.89
.2	9.60	.4	9.06	.6	8.22	.5	6.73	182.	5.49	237.	4.22	334.	2.99	535.	1.87
.3	9.59	.6	9.04	.8	8.21	149.	6.71	183.	5.46	238.	4.20	336.	2.98	540.	1.85
.4	9.58	.8	9.03	122.	8.20	.5	6.69	184.	5.43	239.	4.18	338.	2.96	545.	1.83
.5	9.57	111.	9.01	.5	8.16	150.	6.67	185.	5.41	240.	4.17	340.	2.94	550.	1.82
.6	9.56	.2	8.99	123.	8.13	.5	6.64	186.	5.38	241.	4.15	342.	2.92	555.	1.80
.7	9.55	.4	8.98	.5	8.10	151.	6.62	187.	5.35	242.	4.13	344.	2.91	560.	1.79
.8	9.54	.6	8.96	124.	8.06	.5	6.60	188.	5.32	243.	4.12	346.	2.89	565.	1.77
.9	9.53	.8	8.94	.5	8.03	152.	6.58	189.	5.29	244.	4.10	348.	2.87	570.	1.75
105.	9.52	112.	8.93	125.	8.00	.5	6.56	190.	5.26	245.	4.08	350.	2.86	575.	1.74
.1	9.51	.2	8.91	.5	7.97	153.	6.54	191.	5.24	246.	4.07	352.	2.84	580.	1.72
.2	9.51	.4	8.90	126.	7.94	.5	6.51	192.	5.21	247.	4.05	354.	2.82	585.	1.71
.3	9.50	.6	8.88	.5	7.91	154.	6.49	193.	5.18	248.	4.03	356.	2.81	590.	1.69
.4	9.49	.8	8.87	127.	7.87	.5	6.47	194.	4.15	249.	4.02	358.	2.79	595.	1.68
.5	9.48	113.	8.85	.5	7.84	155.	6.45	195.	5.13	250.	4.00	360.	2.78	600.	1.67
.6	9.47	.2	8.83	128.	7.81	.5	6.43	196.	5.10	252.	3.97	362.	2.76	610.	1.64
.7	9.46	.4	8.82	.5	7.78	156.	6.41	197.	5.08	254.	3.94	364.	2.75	620.	1.61
.8	9.45	.6	8.80	129.	7.75	.5	6.39	198.	5.05	256.	3.91	366.	2.73	630.	1.59
.9	9.44	.8	8.79	.5	7.72	157.	6.36	199.	5.03	258.	3.88	368.	2.72	640.	1.56

YARN TABLE (continued)

For numbering Cotton Yarn by weight in grains of 120 yards or 1 skein.

106.	9.43	114.	8.77	130.	7.69	.5	6.35	200.	5.00	260.	3.85	370.	2.70	650.	1.54
.1	9.43	.2	8.76	.5	7.66	158.	6.33	201.	4.98	262.	3.82	372.	2.69	660.	1.52
.2	9.42	.4	8.74	131.	7.63	.5	6.31	202.	4.95	264.	3.79	374.	2.67	670.	1.49
.3	9.41	.6	8.73	.5	7.60	159.	6.29	203.	4.93	266.	3.76	376.	2.66	680.	1.47
.4	9.40	.8	8.71	132.	7.58	.5	6.27	204.	4.90	268.	3.73	378.	2.65	690.	1.45
.5	9.39	115.	8.70	.5	7.55	160.	6.25	205.	4.88	270.	3.70	380.	2.63	700.	1.43
.6	9.38	.2	8.68	133.	7.52	.5	6.23	206.	4.85	272.	3.68	382.	2.62	710.	1.41
.7	9.37	.4	8.67	.5	7.49	161.	6.21	207.	4.83	274.	3.65	385.	2.60	720.	1.39
.8	9.36	.6	8.65	134.	7.46	.5	6.19	208.	4.81	276.	3.62	390.	2.56	730.	1.37
.9	9.35	.8	8.64	.5	7.43	162.	6.17	209.	4.78	278.	3.60	395.	2.53	740.	1.35
107.	9.35	116.	8.62	135.	7.41	.5	6.15	210.	4.76	280.	3.57	400.	2.50	750.	1.33
.1	9.34	.2	8.61	.5	7.38	163.	6.13	211.	4.74	282.	3.55	405.	2.47	760.	1.32
.2	9.33	.4	8.59	136.	7.35	.5	6.12	212.	4.72	284.	3.52	410.	2.44	770.	1.30
.3	9.32	.6	8.58	.5	7.33	164.	6.10	213.	4.69	286.	3.50	415.	2.41	780.	1.28
.4	9.31	.8	8.56	137.	7.30	.5	6.08	214.	4.67	288.	3.47	420.	2.38	790.	1.27
.5	9.30	117.	8.55	.5	7.27	165.	6.06	215.	4.65	290.	3.45	425.	2.35	800.	1.25
.6	9.29	.2	8.53	138.	7.25	.5	6.04	216.	4.63	292.	3.42	430.	2.33	820.	1.22
.7	9.29	.4	8.52	.5	7.22	166.	6.02	217.	4.61	294.	3.40	435.	2.30	840.	1.19
.8	9.28	.6	8.50	139.	7.19	.5	6.01	218.	4.59	296.	3.33	440.	2.27	860.	1.16
.9	9.27	.8	8.49	.5	7.17	167.	5.99	219.	4.57	298.	3.36	445.	2.25	880.	1.14
108.	9.26	118.	8.47	140.	7.14	.5	5.97	220.	4.55	300.	3.33	450.	2.22	900.	1.11
.1	9.25	.2	8.46	.5	7.12	168.	5.95	221.	4.52	302.	3.31	455.	2.20	925.	1.08
.2	9.24	.4	8.45	141.	7.09	.5	5.93	222.	4.50	304.	3.29	460.	2.17	950.	1.05
.3	9.23	.6	8.43	.5	7.07	169.	5.92	223.	4.48	306.	3.27	465.	2.15	975.	1.03
.4	9.23	.8	8.42	142.	7.04	.5	5.90	224.	4.46	308.	3.25	470.	2.13	1000.	1.00

YARN TABLE

For Numbering Yarn by the Weight, in Grains, of 840 Yards, or One Hank.

Number of Yarn	Grains Per Hank	Number of Yarn	Grains Per Hank	Number of Yarn	Grains Per Hank	Number of Yarn	Grains Per Hank	Number of Yarn	Grains Per Hank	Number of Yarn	Grains Per Hank
9	777.78	20	350.00	31	225.81	42	166.67	53	132.08	76	92.1
9¼	756.76	20¼	345.68	31¼	224.00	42¼	165.68	53¼	131.46	77	90.9
9½	736.84	20½	341.46	31½	222.22	42½	164.71	53½	130.84	78	89.7
9¾	717.95	20¾	337.35	31¾	220.47	42¾	163.74	53¾	130.23	79	88.6
10	700.00	21	333.33	32	218.75	43	162.79	54	129.63	80	87.5
10¼	682.93	21¼	329.41	32¼	217.05	43¼	161.85	54¼	129.03	81	86.4
10½	666.67	21½	325.58	32½	215.38	43½	160.92	54½	128.44	82	85.4
10¾	651.16	21¾	321.84	32¾	213.74	43¾	160.00	54¾	127.85	83	83.3
11	636.36	22	318.18	33	212.12	44	159.09	55	127.27	84	84.3
11¼	622.22	22¼	314.61	33¼	210.52	44¼	158.19	55¼	126.70	85	82.4
11½	608.70	22½	311.11	33½	208.96	44½	157.30	55½	126.13	86	81.4
11¾	595.74	22¾	307.69	33¾	207.41	44¾	156.42	55¾	125.56	87	80.5
12	583.33	23	304.35	34	205.88	45	155.56	56	125.00	88	79.5
12¼	571.43	23¼	301.08	34¼	204.38	45¼	154.70	56¼	124.44	89	78.7
12½	560.00	23½	297.87	34½	202.90	45½	153.85	56½	123.89	90	77.8
12¾	549.02	23¾	294.74	34¾	201.44	45¾	153.01	56¾	123.35	91	76.9
13	538.46	24	291.67	35	200.00	46	152.17	57	122.81	92	76.1
13¼	528.30	24¼	288.66	35¼	198.58	46¼	151.35	57¼	122.27	93	75.3
13½	518.52	24½	285.71	35½	197.18	46½	150.54	57½	121.74	94	74.5
13¾	509.09	24¾	282.83	35¾	195.80	46¾	149.73	57¾	121.21	95	73.7
14	500.00	25	280.00	36	194.44	47	148.94	58	120.69	96	72.9
14¼	491.23	25¼	277.23	36¼	193.10	47¼	148.15	58¼	120.17	97	72.2
14½	482.76	25½	274.51	36½	191.78	47¼	147.37	58½	119.66	98	71.4
14¾	474.58	25¾	271.84	36¾	190.48	47¾	146.60	58¾	119.15	99	70.7
15	466.67	26	269.23	37	189.19	48	145.83	59	118.64	100	70.0
15¼	459.02	26¼	266.67	37¼	187.92	48¼	145.08	59¼	118.14	105	66.7
15½	451.61	26½	264.15	37½	186.67	48½	144.33	59½	117.64	110	63.6
15¾	444.44	26¾	261.68	37¾	185.43	48¾	143.59	59¾	117.15	115	60.9
16	437.50	27	259.26	38	184.21	49	142.86	60	115.67	120	58.3
16¼	430.77	27¼	256.88	38¼	183.01	49¼	142.13	61	114.8	125	56.0
16½	424.24	27½	254.55	38½	181.82	49½	141.41	62	112.9	130	53.8
16¾	417.91	27¾	252.25	38¾	180.65	49¾	140.70	63	111.1	135	51.9
17	411.76	28	250.00	39	179.49	50	140.00	64	109.4	140	50.0
17¼	405.80	28¼	247.79	39¼	178.35	50¼	139.30	65	107.7	145	48.3
17½	400.00	28½	245.61	39½	177.21	50½	138.61	66	106.1	150	46.7
17¾	394.37	28¾	243.48	39¾	176.10	50¾	137.93	67	104.5	155	45.2
18	388.89	29	241.38	40	175.00	51	137.25	68	102.9	160	43.7
18¼	383.56	29¼	239.32	40¼	173.91	51¼	136.59	69	101.4	165	42.4
18½	378.38	29½	237.29	40½	172.84	51½	135.92	70	100.0	170	41.2
18¾	373.33	29¾	235.29	40¾	171.78	51¾	135.27	71	98.6	175	40.0
19	368.42	30	233.33	41	170.73	52	134.62	72	97.2	180	38.9
19¼	363.64	30¼	231.40	41¼	169.70	52¼	133.97	73	95.9	185	37.8
19½	358.97	30½	229.51	41½	168.67	52½	133.33	74	94.6	190	36.8
19¾	354.43	30¾	227.64	41¾	167.66	52¾	132.70	75	93.3	195	35.9
—	—	—	—	—	—	—	—	—	—	200	35.0

BREAKING WEIGHT OF AMERICAN WARP YARNS, PER SKEIN

By George Draper

Weight given in pounds and tenths.

No.	Breaking Weight	No.	Breaking Weight	No.	Breaking Weight	No.	Breaking Weight
1	–	26	66.3	51	36.6	76	25.8
2	–	27	63.6	52	36.1	77	25.5
3	530.0	28	61.3	53	35.5	78	25.3
4	410.0	29	59.2	54	34.9	79	24.9
5	330.0	30	57.3	55	34.4	80	24.6
6	275.0	31	55.6	56	33.8	81	24.3
7	237.6	32	54.0	57	33.4	82	24.0
8	209.0	33	52.6	58	32.8	83	23.7
9	186.5	34	51.2	59	32.3	84	23.4
10	168.7	35	50.0	60	31.7	85	23.2
11	154.1	36	48.7	61	31.3	86	22.8
12	142.0	37	47.6	62	30.8	87	22.6
13	131.5	38	46.5	63	30.4	88	22.4
14	122.8	39	45.5	64	30.0	89	22.2
15	115.1	40	44.6	65	29.6	90	22.0
16	108.4	41	43.8	66	29.2	91	21.7
17	102.5	42	43.0	67	28.8	92	21.5
18	97.3	43	42.2	68	28.5	93	21.3
19	92.6	44	41.4	69	28.2	94	21.2
20	88.3	45	40.7	70	27.8	95	21.0
21	83.8	46	40.0	71	27.4	96	20.7
22	79.7	47	39.3	72	27.1	97	20.5
23	75.9	48	38.6	73	26.8	98	20.4
24	72.4	49	37.9	74	26.5	99	20.2
25	69.2	50	37.3	75	26.2	100	20.0

CALCULATIONS:

840 yards = 1 Hank
$\frac{1}{7}$ of 840 yards = 120 yards 1 Skein.
7000 grains = 1 lb. Avoirdupois.
$\frac{1}{7}$ of 7000 grains = 1000 grains.

$\frac{7000}{840}$ or $\frac{1000}{120} = 8\frac{1}{3}$ which, multiplied by the length in yards, and the product divided by its weight in grains, gives Number of Yarn.

Dividing 7000 by the weight in grains of one hank of 840 yards gives the number of yarn, or, Dividing 1000 by the weight in grains of one skein of 120 yards gives the number of the yarn.

HYDE'S TABLE

BREAKING WEIGHT OF ENGLISH WARP YARNS PER SKEIN

Weight given in pounds and tenths.

No. YARN	BREAKING WEIGHT				
	Ordinary	Fair	Good	Extra	Super-Extra
10	115.6	120.5	125.4	130.2	135.2
11	102.2	104.4	106.6	108.9	111.1
12	96.9	99.1	100.3	103.5	105.7
13	91.9	93.9	96.0	98.1	100.2
14	89.7	91.7	93.8	95.9	97.9
15	83.7	85.6	87.5	89.4	91.4
16	81.7	83.5	85.4	87.2	89.1
17	76.9	78.6	80.4	82.1	83.9
18	72.6	74.2	75.9	77.5	79.2
20	67.9	69.4	70.9	72.4	74.0
22	61.7	63.1	64.4	65.9	67.3
24	58.6	59.9	61.2	62.6	63.9
26	54.6	55.8	57.1	58.3	59.6
28	50.2	51.4	52.5	53.6	54.8
30	48.7	49.7	50.8	51.9	53.0
32	45.6	46.4	47.3	48.2	49.1
34	44.4	45.4	46.4	47.4	48.4
36	41.9	42.8	43.7	44.7	45.7
38	39.7	40.6	41.4	42.4	43.3
40	38.9	39.8	40.7	41.6	42.5
42	37.8	38.6	39.5	40.4	41.2
44	35.2	36.2	37.0	37.8	38.6
46	33.8	34.6	35.3	36.1	36.9
48	32.2	32.9	34.6	34.3	35.1
50	32.1	32.8	33.5	34.2	35.0
55	30.5	31.2	31.9	32.6	33.3
60	27.6	28.2	28.9	29.5	30.1
65	25.5	26.1	26.6	27.2	27.8
70	24.4	24.9	25.5	26.1	26.6
75	22.7	23.2	23.7	24.2	24.8
80	22.0	22.5	23.0	23.5	24.0
85	20.2	20.8	21.4	21.0	22.5
90	19.5	19.2	19.9	20.6	21.3
95	18.5	18.9	19.3	19.7	20.2
100	18.2	18.6	19.0	19.4	19.7
110	15.6	16.0	16.3	16.7	17.0
120	15.5	15.8	16.1	16.4	16.8
130	14.2	14.6	14.9	15.2	15.6
140	13.6	13.9	14.2	14.6	14.9
150	12.4	12.7	12.9	13.2	13.6

Showing the Square Root of the Numbers or Counts, from One to Two Hundred Hanks in the Pound, with the Twist per Inch for Different Kinds of Yarns.

The heavy figures opposite No. 1 show the multipliers for the square root of all number throughout the tables.

Counts or Numbers	Square Root	Extra Mule Twist	Mule Twists	Weft Twist	Twist for Doubling	Hosiery Yarn
1	1.00	4.20	**3.75**	**3.25**	**2.75**	**2.50**
2	1.41	5.65	5.30	4.60	3.88	3.53
3	1.73	6.92	6.49	5.62	4.76	4.33
4	2.00	8.00	7.50	6.50	5.50	5.00
5	2.23	8.94	8.37	7.26	6.14	5.59
6	2.44	9.79	9.18	7.96	6.73	6.12
7	2.64	10.58	9.92	8.59	7.27	6.61
8	2.82	11.31	10.50	9.19	7.77	7.07
9	3.00	12.00	11.25	9.75	8.25	7.50
10	3.16	12.64	11.85	10.27	8.79	7.90
11	3.31	13.26	12.43	10.77	9.12	8.29
12	3.46	13.85	12.99	11.25	9.52	8.66
14	3.74	14.96	14.03	12.16	10.28	9.35
16	4.00	16.00	15.00	13.00	11.00	10.00
18	4.24	16.97	15.90	13.78	11.66	10.60
20	4.47	17.88	16.77	14.53	12.29	11.18
22	4.69	18.76	17.58	15.24	12.89	
24	4.89	19.59	18.37	15.92	13.47	
26	5.09	20.39	19.11	16.57	14.02	
28	5.29	21.16	19.84	17.19	14.55	
30	5.47	21.90	20.53	17.80	15.06	
35	5.91	23.66	22.18	19.22	16.27	
40	6.32	15.29	23.71	20.55	17.39	
45	6.70	26.83	25.15	21.80	18.44	
50	7.07	28.28	26.51	22.98	19.44	
55	7.41	29.66	27.81	24.10	20.39	
60	7.74	30.98	29.04	25.17	21.30	
65	8.06	32.24	30.23	26.20	22.17	
70	8.36	33.46	31.37	27.19	23.00	
75	8.66	34.64	32.47	28.14	23.81	
80	8.94	35.77	33.54	29.06	24.59	
85	9.21	36.87	34.57	29.96	25.35	
90	9.48	37.94	35.47	30.83	26.08	
95	9.74	38.98	36.55	31.67	26.80	
100	10.00	40.00	37.50	32.50	27.50	
110	10.48	41.95	39.33	34.08	28.84	
120	10.95	43.81	41.07	35.60	30.12	
130	11.40	45.60	42.75	37.05	31.35	
140	11.83	47.32	44.37	38.47	32.54	
150	12.24	48.98	45.92	39.80	33.68	
160	12.64	50.59	47.43	41.10	34.78	
170	13.03	52.15	48.89	42.37	35.85	
180	13.41	53.66	50.31	43.60	36.89	
190	13.78	55.13	51.69	44.79	37.90	
200	14.14	56.56	53.03	45.96	38.89	

RING TRAVELLER TABLE

Warp Yarn					Filling Yarn				
Number of Yarn	Revolutions of Spindles	Diameter of Ring	Number of Traveller	Weight of 10 Travellers in grains	Number of Yarn	Revolutions of Spindles	Diameter of Ring	Number of Traveller	Weight of 10 Travellers in grains
4	4950	2″	14	39	4	4000	1½″	16	44
6	5900	–	12	33	6	4800	–	13	36
8	6700	–	9	23	8	5450	–	10	26
10	7250	–	8	20	10	5950	–	8	20
11	7500	–	7	18	11	6150	–	7	18
12	7750	–	6	16	12	6350	–	6	16
13	7950	–	6	16	13	6500	–	5	14
14	8100	–	5	14	14	6700	–	4	13
15	8300	–	4	13	15	6850	–	3	12
16	8450	–	3	12	16	6950	–	2	11
17	8600	–	2	11	17	7100	–	1	10
18	8750	–	1	10	18	7200	–	1–0	9
19	8850	–	1–0	9	19	7300	–	3–0	8
20	8900	–	2–0	8½	20	7400	–	5–0	7
21	9050	–	3–0	8	21	7500	–	5–0	
22	9100	–	4–0	7½	22	7600	–	6–0	6½
23	9150	–	5–0	7	23	7700	–	6–0	
24	9200	–	6–0	6½	24	7800	–	7–0	6
28	9500	1¾″	7–0	6	28	7900	1⅜″	8–0	5½
32	9500	–	8–0	5½	32	7900	–	9–0	5
34	9600	–	9–0	5	34	7900	–	10–0	4½
36	9700	–	10–0	4½	36	7900	–	11–0	4
38	9800	–	11–0	4	38	7900	–	12–0	3¾
40	9700	1⅝″	12–0	3¾	40	7900	1¼″	13–0	3½
45	9700	1½″	13–0	3½	45	7900	–	14–0	3¼
50	9700	–	14–0	3¼	50	7900	–	15–0	3
55	9600	–	14–0	–	55	7900	–	15–0	
60	9600	–	15–0	3	60	7900	–	16–0	2¾
65	9600	–	15–0	–	65	7800	–	16–0	
70	9500	–	16–0	2¾	70	7800	–	17–0	2½
75	9500	–	16–0	–	75	7800	–	17–0	
80	9300	–	17–0	2½	80	7700	–	18–0	2¼
85	9100	–	17–0	–	85	7600	–	18–0	
90	9100	1⅜″	18–0	2¼	90	7400	–	19–0	2
95	9000	–	19–0	2	95	7400	–	20–0	1¾
100	8700	–	20–0	1¾	100	7200	–	21–0	1½
110	8500	–	21–0	1½	110	6900	–	22–0	1¼

MONTHLY RECORD OF BREAKING STRENGTH OF NO. 28½ WARP YARN SPUN AT PACIFIC YARN MILL, COVERING A PERIOD OF 28 YEARS

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year	Apr. to Sept.	Oct. to March	*Average Yarn No.*
1889	–	–	–	–	–	–	–	63	65.7	63.2	63.7	56.7	62.5	64.4	61.2	*27.28*
1890	58.7	60.2	64.	61.5	65.7	64	59.2	62.2	67.3	65.8	64.5	61.8	62.9	63.3	62.5	*27.43*
1891	61.3	59.5	61.7	59.7	62.5	59	57.3	60	62.2	61	60.5	57.7	60.2	60.1	60.3	*27.89*
1892	58.5	57.8	58.5	56	58	57.7	56.5	60.8	61	54	53.8	58	57.5	58.3	56.8	*28.27*
1893	56	53	47.8	52	52.5	52.8	51	54.5	58	61.2	56	48	53.6	53.5	53.7	*28.32*
1894	48.7	51.7	55.2	51.8	50.3	54.2	52.7	53	57	54.3	54	49.3	52.7	53.2	52.2	*28.31*
1895	51.3	54.8	56.5	58.7	58.3	58.2	56	56.4	54.2	54.2	54.4	53	55.5	57.0	54.0	*28.47*
1896	55	51.8	53.5	52.7	53.8	53.5	56	53	54.3	56.6	59.2	59.7	54.9	53.9	55.9	*28.47*
1897	57	55	57.2	56.4	57	55.2	57	54	52	55.8	62	58.8	56.4	55.3	57.6	*28.33*
1898	57.8	58	58.7	57	57.5	54.5	58.3	57.2	54.2	54.4	52.5	56.8	56.4	56.5	56.4	*28.25*
1899	55.7	55.2	54.5	57.2	57.5	53	52.2	54.7	53.2	53.2	48.8	48.6	53.6	54.5	52.7	*28.46*
1900	50.5	50	53.6	53	57.2	55.8	53.8	54.3	55.8	59.5	55	51	54.1	55.0	53.3	*28.04*
1901	50.2	55.8	60	59	57.5	58.4	58.2	59.5	60	61.5	57.4	58.5	58.0	58.8	57.2	*28.39*
1902	58.7	58	56.2	59	59	61.2	61.5	58.7	60.2	59.2	58	53.8	58.6	59.9	57.3	*28.64*
1903	56	57.5	57.2	57.2	56	63.2	60.8	60	59.3	56	56	57.8	58.1	59.4	56.7	*28.57*
1904	59.2	59.5	61.5	60.8	61.8	63	63.6	64	64.7	64	61.2	59.6	61.9	63.0	60.8	*28.68*
1905	61.5	59.5	58	59.4	59.2	62	56	59.2	58.5	57	59	60.4	59.1	59.1	59.2	*28.58*
1906	59	53.5	54.2	55	56.7	62.2	62	61	59.7	58.5	56	56	57.8	59.4	56.2	28.31
1907	56.5	54.2	55.4	55	56.7	56.6	54.2	55	59	55.5	55.4	55	55.7	56.1	55.3	*28.50*
1908	54.7	53.2	57.5	54.5	57	60	61.7	58.4	56.3	55.2	55	54.7	56.5	58.0	55.0	*28.63*
1909	54.2	55.2	58.2	59.4	60.7	61	60.2	60.5	64.6	62	60.2	58.2	59.5	61.1	58.0	*28.43*
1910	59.4	59	57.5	58.8	60.2	61.5	59.2	64.7	62	58.8	57	57.4	59.6	61.1	58.2	*28.67*
1911	57.5	58.2	61.5	59.8	59.2	61.5	60	64.3	62.2	60.5	61	60.4	60.5	61.2	59.8	*28.52*
1912	58.7	58	56.8	56.5	58.2	56.8	56.7	57.4	55.5	57.5	57	56	57.1	56.8	57.3	*28.35*
1913	57.5	56.2	56.8	55.7	57.8	57	56.2	58.5	61.5	61	57.4	59	57.9	57.8	58.0	*28.44*
1914	56.8	56	56.2	55.5	52.6	52.2	55.5	58	56.6	57	57.7	56.5	55.9	55.1	56.7	*28.36*
1915	53.8	55.2	54	55.9	56.2	56	55.2	56	53.3	54.6	54	53.6	54.8	55.4	54.2	*28.38*
1916	53.2	53.2	53.7	54.4	53.0	54.0	57.0	56	57.7	55.0	56.7	58.2	55.2	55.4	55.0	*28.39*
1917	57.7	57.7	57.2	60.0	59.0	59.4	59.0	60	59.2	59.0	57.7	56.2	58.5	59.4	57.6	*28.33*
Average	*56.2*	*56.0*	*56.9*	*56.8*	*57.5*	*58.0*	*57.4*	*58.4*	*58.8*	*58.1*	*57.3*	*56.2*	*57.4*	*58.0*	*56.8*	*28.33*

RING SPINNING

To find 100 per cent. Production per Spindle:

$$\frac{\text{Circum. of Front Roll} \times \text{Rev. per M.} \times \text{Minutes} \times \text{Hours}}{36 \text{ inches} \times 840 \times \text{No. of Yarn}} = \text{Lbs. per Spindle.}$$

EXAMPLE:

$$\frac{3.1416 \times 90 \times 60 \times 54}{36 \times 840 \times 52} = .582 \text{ Lbs. per spindle.}$$

To find the average number of sides run for 54 hours:

Multiply the Number of Sides by the Number of Hours each has run and divide the total number of hours by 54.

EXAMPLE:

206	sides	ran	21	hours	206 x 21	4,326
204	"	"	$10\frac{1}{2}$	"	204 x $10\frac{1}{2}$	2,142
200	"	"	$10\frac{1}{2}$	"	200 x $10\frac{1}{2}$	2,100
194	"	"	16	"	194 x 16	3,104
						11,672

11,672 ÷ 54 = 216 Sides Run for 54 hours.

ROVING FRAMES

To find 100 per cent. Production of Roving Frames from speed of Front Roll:

$$\frac{\text{Circum. of Front Roll} \times \text{Rev. per M.} \times \text{Minutes} \times \text{Hours}}{36 \text{ inches} \times 840} = \text{Hanks per spindle.}$$

EXAMPLE: Assume speed of front roll 80 r. p. m.
" circum. " " 3.927 inches.

$$\frac{3.927 \times 80 \times 60 \times 54}{36 \times 840} = 33.66 \text{ Hanks per spindle.}$$

YARN ORGANIZATIONS

Yarn Number	Lap Oz. Per Yd.	Card		Draw-Frame		Slubber			Interme-diate			Fine Frame			Jack Frame			Spin-ning	
		Draft	Sliver Grains	Sliver Grains	Sliver Hank	Doublings	Draft	Hank	Doublings	Draft	Hank	Doublings	Draft	Hank	Doublings	Draft	Hank	Doublings	Draft
6	16	93	75	75	.111	1	3.6	.40	2	5.	1.00	–	–	–	–	–	–	1	6.
8	16	–	75	75	.111	1	4.5	.50	2	5.	1.25	–	–	–	–	–	–	1	6.4
10	14	94	65	65	.128	1	3.9	.50	2	5.3	1.33	–	–	–	–	–	–	1	7.5
12	14	–	65	65	.128	1	4.7	.60	2	5.3	1.60	–	–	–	–	–	–	1	7.5
–	14	–	65	65	.128	1	3.9	.50	2	4.	1.00	2	5.	2.50	–	–	–	2	9.6
14	14	–	65	65	.128	1	4.7	.60	2	5.3	1.60	–	–	–	–	–	–	1	8.8
–	14	–	65	65	.128	1	3.9	.50	2	4.	1.00	2	5.	2.50	–	–	–	2	11.2
16	14	–	65	65	.128	1	4.7	.60	2	6.	1.80	–	–	–	–	–	–	1	8.8
–	14	–	65	65	.128	1	3.9	.50	2	4.	1.00	2	6.	3.00	–	–	–	2	10.6
18	14	–	65	65	.128	1	3.9	.50	2	4.	1.00	2	5.	2.50	–	–	–	1	7.2
–	14	–	65	65	.128	1	3.9	.50	2	4.	1.00	2	6.	3.00	–	–	–	2	12.0
20	13	95	60	65	.128	1	3.9	.50	2	4.	1.00	2	5.	2.50	–	–	–	1	8.0
–	13	–	60	65	.128	1	3.9	.50	2	5.3	1.33	2	6.	4.00	–	–	–	2	10.0
22	13	–	60	65	.128	1	3.9	.50	2	4.	1.00	2	5.	2.50	–	–	–	1	8.8
–	13	–	60	65	.128	1	3.9	.50	2	5.3	1.33	2	6.	4.00	–	–	–	2	11.0
24	13	–	60	65	.128	1	3.9	.50	2	4.	1.00	2	5.	2.50	–	–	–	1	8.0
–	13	–	60	65	.128	1	3.9	.50	2	5.3	1.33	2	6.	4.00	–	–	–	2	12.0
26	13	–	60	65	.128	1	3.9	.50	2	4.	1.00	2	6.	3.00	–	–	–	1	8.7
–	13	–	60	65	.128	1	4.7	.60	2	5.	1.50	2	6.	4.50	–	–	–	2	11.6
28	12	–	50	60	.139	1	3.6	.50	2	5.3	1.33	2	5.3	3.50	–	–	–	1	8.0
–	12	–	50	60	.139	1	4.7	.65	2	5.5	1.80	2	6.1	5.50	–	–	–	2	10.2
30	12	–	50	60	.139	1	3.6	.50	2	5.3	1.33	2	5.3	3.50	–	–	–	1	8.6
–	12	–	50	60	.139	1	4.7	.65	2	5.5	1.80	2	6.1	5.50	–	–	–	2	10.9
32	12	–	50	60	.139	1	3.6	.50	2	5.3	1.33	2	6.	4.00	–	–	–	1	8.0
–	12	–	50	60	.139	1	4.7	.65	2	5.5	1.80	2	6.1	5.50	–	–	–	2	11.6
34	12	–	50	60	.139	1	3.6	.50	2	5.3	1.33	2	6.	4.00	–	–	–	1	8.5
–	12	–	50	60	.139	1	4.7	.65	2	5.5	1.80	2	6.1	5.50	–	–	–	2	12.4
36	12	–	50	60	.139	1	3.6	.50	2	5.3	1.33	2	6.	4.00	–	–	–	1	9.0
–	12	–	50	60	.139	1	3.6	.50	2	4.	1.00	2	5.	2.50	2	5.2	6.5	2	11.1
38	12	–	50	60	.139	1	3.6	.50	2	5.3	1.33	2	6.	4.00	–	–	–	1	9.5
–	12	–	50	60	.139	1	3.6	.50	2	4.	1.00	2	5.	2.50	2	5.2	6.5	2	11.7
40	12	–	50	60	.139	1	3.6	.50	2	4.	1.00	2	5.	2.50	2	6.4	8.0	2	10.0
50	12	117	45	60	.139	1	3.6	.50	2	4.	1.00	2	6.	3.00	2	6.7	10.	2	10.0
60	12	–	45	60	.139	1	4.3	.60	2	5.	1.50	2	5.3	4.00	2	6.0	12.	2	10.0
70	12	–	45	60	.139	1	4.3	.60	2	5.	1.50	2	6.	4.50	2	6.2	14.	2	10.0
80	12	–	45	60	.139	1	4.7	.65	2	5.5	1.80	2	5.6	5.00	2	6.4	16.	2	10.0
90	12	–	45	60	.139	1	4.7	.65	2	5.5	1.80	2	6.1	5.50	2	6.5	18.	2	10.0
100	12	–	45	60	.139	1	4.7	.65	2	5.5	1.80	2	6.4	5.75	2	7.0	20.	2	10.0
110	11	137	35	50	.167	1	4.8	.80	2	5.5	2.25	2	6.	6.76	2	6.5	22.	2	10.0
120	11	–	35	50	.167	1	4.8	.80	2	5.5	2.25	2	6.	6.75	2	7.1	24.	2	10.0

YARDS OF CLOTH PER LOOM PER HOUR

No allowance for stops.

Picks Per Inch	Picks Per Minute										
	100	105	110	115	120	125	130	135	140	145	150
20	8.33	8.75	9.17	9.58	10.00	10.42	10.83	11.25	11.67	12.08	12.50
22	7.58	7.95	8.33	8.71	9.09	9.47	9.85	10.23	10.61	10.98	11.36
24	6.94	7.29	7.64	7.99	8.33	8.68	9.03	9.37	9.72	10.07	10.42
26	6.41	6.73	7.05	7.37	7.69	8.01	8.33	8.65	8.97	9.29	9.62
28	5.95	6.25	6.55	6.85	7.14	7.44	7.74	8.04	8.33	8.63	8.93
30	5.56	5.83	6.11	6.39	6.67	6.94	7.22	7.50	7.78	8.06	8.33
32	5.21	5.47	5.73	5.99	6.25	6.51	6.77	7.03	7.29	7.55	7.81
34	4.90	5.15	5.39	5.64	5.88	6.13	6.37	6.62	6.86	7.11	7.35
36	4.63	4.86	5.09	5.32	5.56	5.79	6.02	6.25	6.48	6.71	6.94
38	4.39	4.61	4.82	5.04	5.26	5.48	5.70	5.92	6.14	6.36	6.58
40	4.17	4.37	4.58	4.79	5.00	5.21	5.42	5.63	5.83	6.04	6.25
42	3.97	4.17	4.37	4.56	4.76	4.96	5.16	5.36	5.56	5.75	5.95
44	3.79	3.98	4.17	4.36	4.55	4.73	4.92	5.11	5.30	5.49	5.68
46	3.62	3.80	3.99	4.17	4.35	4.53	4.71	4.89	5.07	5.25	5.43
48	3.47	3.65	3.82	3.99	4.17	4.34	4.51	4.69	4.86	5.03	5.21
50	3.33	3.50	3.67	3.83	4.00	4.17	4.33	4.50	4.67	4.83	5.00
52	3.21	3.37	3.53	3.69	3.85	4.01	4.17	4.33	4.49	4.65	4.81
54	3.09	3.24	3.40	3.55	3.70	3.86	4.01	4.17	4.32	4.48	4.63
56	2.98	3.13	3.27	3.42	3.57	3.72	3.87	4.02	4.17	4.32	4.46
58	2.87	3.02	3.16	3.30	3.45	3.59	3.74	3.88	4.02	4.17	4.31
60	2.78	2.92	3.06	3.19	3.33	3.47	3.61	3.75	3.89	4.03	4.17
62	2.69	2.82	2.96	3.09	3.23	3.36	3.49	3.63	3.76	3.90	4.03
64	2.60	2.73	2.86	2.99	3.13	3.26	3.39	3.52	3.65	3.78	3.91
66	2.53	2.65	2.78	2.90	3.03	3.16	3.28	3.41	3.54	3.66	3.79
68	2.45	2.57	2.70	2.82	2.94	3.06	3.19	3.31	3.43	3.55	3.68
70	2.38	2.50	2.62	2.74	2.86	2.98	3.10	3.21	3.33	3.45	3.57
72	2.31	2.43	2.55	2.66	2.78	2.89	3.01	3.13	3.24	3.36	3.47
74	2.25	2.36	2.48	2.59	2.70	2.82	2.93	3.04	3.15	3.27	3.38
76	2.19	2.30	2.41	2.52	2.63	2.74	2.85	2.96	3.07	3.18	3.29
78	2.14	2.24	2.35	2.46	2.56	2.67	2.78	2.88	2.99	3.14	3.21
80	2.08	2.19	2.29	2.40	2.50	2.60	2.71	2.81	2.92	3.02	3.13
82	2.03	2.13	2.24	2.34	2.44	2.54	2.64	2.74	2.85	2.95	3.05
84	1.98	2.08	2.18	2.28	2.38	2.48	2.58	2.68	2.78	2.88	3.98
86	1.94	2.03	2.13	2.23	2.33	2.42	2.52	2.62	2.71	2.81	2.91
88	1.89	1.99	2.08	2.18	2.27	2.37	2.46	2.56	2.65	2.75	2.84
90	1.85	1.94	2.04	2.13	2.22	2.31	2.41	2.50	2.59	2.69	2.78
92	1.81	1.90	1.99	2.08	2.17	2.26	2.36	2.45	2.54	2.63	2.72
94	1.77	1.86	1.95	2.04	2.13	2.22	2.30	2.39	2.48	2.57	2.66
96	1.74	1.82	1.91	2.00	2.08	2.17	2.26	2.34	2.43	2.52	2.60
98	1.70	1.79	1.87	1.96	2.04	2.13	2.21	2.30	2.38	2.47	2.55
100	1.67	1.75	1.83	1.92	2.00	2.08	2.17	2.25	2.33	2.42	2.50

YARDS OF CLOTH PER LOOM PER HOUR

No allowance for stops.

Picks Per Inch	Picks per Minute										
	155	160	165	170	175	180	185	190	195	200	205
20	12.92	13.33	13.75	14.17	14.58	15.00	15.42	15.83	16.25	16.67	17.08
22	11.74	12.12	12.50	12.88	13.26	13.64	14.02	14.39	14.77	15.15	15.53
24	10.76	11.11	11.46	11.81	12.15	12.50	12.85	13.19	13.54	13.89	14.24
26	9.94	10.26	10.58	10.90	11.22	11.54	11.86	12.18	12.50	12.82	13.14
28	9.23	9.52	9.82	10.12	10.42	10.71	11.01	11.31	11.61	11.90	12.20
30	8.61	8.89	9.17	9.44	9.72	10.00	10.28	10.58	10.83	11.11	11.39
32	8.07	8.33	8.59	8.85	9.11	9.37	9.64	9.90	10.16	10.42	10.68
34	7.60	7.84	8.09	8.33	8.58	8.82	9.07	9.31	9.56	9.80	10.05
36	7.18	7.41	7.64	7.87	8.10	8.33	8.56	8.80	9.03	9.26	9.49
38	6.80	7.02	7.24	7.46	7.68	7.89	8.11	8.33	8.55	8.77	8.99
40	6.46	6.67	6.87	7.08	7.29	7.50	7.71	7.92	8.13	8.33	8.54
42	6.15	6.35	6.55	6.75	6.94	7.14	7.34	7.54	7.74	7.94	8.13
44	5.87	6.06	6.25	6.44	6.63	6.82	7.01	7.20	7.39	7.58	7.77
46	5.62	5.80	5.98	6.16	6.34	6.52	6.70	6.88	7.07	7.25	7.43
48	5.38	5.56	5.73	5.90	6.08	6.25	6.42	6.60	6.77	6.94	7.12
50	5.17	5.33	5.50	5.67	5.83	6.00	6.17	6.33	6.50	6.67	6.83
52	4.97	5.13	5.29	5.45	5.61	5.77	5.93	6.09	6.25	6.41	6.57
54	4.78	4.94	5.09	5.25	5.40	5.56	5.71	5.86	6.02	6.17	6.33
56	4.61	4.76	4.91	5.06	5.21	5.36	5.51	5.65	5.80	5.95	6.10
58	4.45	4.60	4.74	4.88	5.03	5.17	5.32	5.46	5.60	5.75	5.89
60	4.31	4.44	4.58	4.72	4.86	5.00	5.14	5.28	5.42	5.56	5.69
62	4.17	4.30	4.44	4.57	4.70	4.84	4.97	5.11	5.24	5.38	5.51
64	4.04	4.17	4.30	4.43	4.56	4.69	4.82	4.95	5.08	5.21	5.34
66	3.91	4.04	4.17	4.29	4.42	4.55	4.67	4.80	4.92	5.05	5.18
68	3.80	3.92	4.04	4.17	4.29	4.41	4.53	4.66	4.78	4.90	5.02
70	3.69	3.81	3.93	4.05	4.17	4.29	4.40	4.52	4.64	4.76	4.88
72	3.59	3.70	3.82	3.94	4.05	4.17	4.28	4.40	4.51	4.63	4.75
74	3.49	3.60	3.72	3.83	3.94	4.05	4.17	4.28	4.39	4.50	4.62
76	3.40	3.51	3.62	3.73	3.84	3.95	4.06	4.17	4.28	4.29	4.50
78	3.31	3.42	3.53	3.63	3.74	3.85	3.95	4.06	4.17	4.27	4.38
80	3.23	3.33	3.44	3.54	3.65	3.75	3.85	3.96	4.06	4.17	4.27
82	3.15	3.25	3.35	3.46	3.56	3.66	3.76	3.86	3.96	4.07	4.17
84	3.08	3.17	3.27	3.37	3.47	3.57	3.66	3.77	3.87	3.97	4.07
86	3.00	3.10	3.20	3.29	3.39	3.49	3.58	3.68	3.78	3.88	3.97
88	2.94	3.03	3.13	3.22	3.31	3.41	3.50	3.60	3.69	3.79	3.88
90	2.87	2.96	3.06	3.15	3.24	3.33	3.43	3.52	3.61	3.70	3.80
92	2.81	2.90	2.99	3.08	3.17	3.26	3.35	3.44	3.53	3.62	3.71
94	2.75	2.84	2.93	3.01	3.10	3.19	3.28	3.37	3.46	3.55	3.63
96	2.69	2.78	2.86	2.95	3.04	3.13	3.21	3.30	3.39	3.47	3.56
98	2.64	2.72	2.81	2.89	2.98	3.06	3.15	3.23	3.32	3.40	3.49
100	2.58	2.67	2.75	2.83	2.92	3.00	3.08	3.17	3.25	3.33	3.44

YARDS OF CLOTH PER LOOM PER HOUR (cont.)

No allowance for stops.

Picks Per Inch	Picks Per Minute										
	100	105	110	115	120	125	130	135	140	145	150
102	1.63	1.72	1.80	1.88	1.96	2.04	2.12	2.21	2.29	2.37	2.45
104	1.60	1.68	1.76	1.84	1.92	2.00	2.08	2.16	2.24	2.32	2.40
106	1.57	1.65	1.73	1.81	1.89	1.97	2.04	2.12	2.20	2.28	2.36
108	1.54	1.62	1.70	1.77	1.85	1.93	2.01	2.08	2.16	2.24	2.31
110	1.52	1.59	1.67	1.74	1.82	1.89	1.97	2.05	2.12	2.20	2.27
112	1.49	1.56	1.64	1.71	1.79	1.86	1.93	2.01	2.08	2.16	2.23
114	1.46	1.54	1.61	1.68	1.75	1.83	1.90	1.97	2.05	2.12	2.19
116	1.44	1.51	1.58	1.65	1.72	1.80	1.87	1.94	2.01	2.08	2.16
118	1.41	1.48	1.55	1.62	1.69	1.77	1.84	1.91	1.98	2.05	2.12
120	1.39	1.46	1.53	1.60	1.67	1.74	1.81	1.87	1.94	2.01	2.08
122	1.37	1.43	1.50	1.57	1.64	1.71	1.78	1.84	1.91	1.98	2.04
124	1.34	1.41	1.48	1.55	1.61	1.68	1.75	1.81	1.88	1.95	2.01
126	1.32	1.39	1.46	1.52	1.59	1.65	1.72	1.79	1.85	1.92	1.98
128	1.30	1.37	1.43	1.50	1.56	1.63	1.69	1.76	1.82	1.89	1.95
130	1.28	1.35	1.41	1.47	1.54	1.60	1.67	1.73	1.79	1.86	1.92
134	1.24	1.31	1.37	1.43	1.49	1.55	1.62	1.68	1.74	1.80	1.87
136	1.23	1.29	1.35	1.41	1.47	1.53	1.59	1.65	1.72	1.78	1.84
140	1.19	1.25	1.31	1.37	1.43	1.49	1.55	1.61	1.67	1.73	1.79
144	1.16	1.22	1.27	1.33	1.39	1.45	1.50	1.56	1.62	1.68	1.74
146	1.14	1.20	1.26	1.31	1.37	1.43	1.48	1.54	1.60	1.66	1.71
150	1.11	1.17	1.22	1.28	1.33	1.39	1.44	1.50	1.56	1.61	1.67
154	1.08	1.14	1.19	1.24	1.30	1.35	1.41	1.46	1.52	1.57	1.62
156	1.07	1.12	1.18	1.23	1.28	1.34	1.39	1.44	1.50	1.55	1.60
160	1.04	1.09	1.15	1.20	1.25	1.30	1.35	1.41	1.46	1.51	1.56
164	1.02	1.07	1.12	1.17	1.22	1.27	1.32	1.37	1.42	1.47	1.52
166	1.00	1.05	1.10	1.15	1.20	1.26	1.31	1.35	1.41	1.46	1.51
170	.98	1.03	1.08	1.13	1.18	1.23	1.27	1.32	1.37	1.42	1.47
174	.96	1.01	1.05	1.10	1.15	1.20	1.25	1.29	1.34	1.39	1.44
176	.95	.99	1.04	1.09	1.14	1.18	1.23	1.28	1.33	1.37	1.42
180	.93	.97	1.02	1.06	1.11	1.16	1.20	1.25	1.30	1.34	1.39

YARDS OF CLOTH PER LOOM PER HOUR

No allowance for stops.

Picks Per Inch	Picks Per Minute										
	155	160	165	170	175	180	185	190	195	200	205
102	2.53	2.61	2.70	2.78	2.86	2.94	3.02	3.10	3.19	3.27	3.35
104	2.48	2.56	2.64	2.72	2.80	2.88	2.96	3.04	3.13	3.21	3.29
106	2.44	2.52	2.59	2.67	2.75	2.83	2.91	2.99	3.07	3.14	3.22
108	2.39	2.47	2.55	2.62	2.70	2.78	2.85	2.93	3.01	3.09	3.16
110	2.35	2.42	2.50	2.58	2.65	2.73	2.80	2.88	2.95	3.03	3.11
112	2.31	2.38	2.46	2.53	2.60	2.68	2.75	2.83	2.90	2.98	3.05
114	2.27	2.34	2.41	2.49	2.56	2.63	2.70	2.78	2.85	2.92	3.00
116	2.23	2.30	2.37	2.44	2.51	2.59	2.66	2.73	2.80	2.87	2.95
118	2.19	2.26	2.33	2.40	2.47	2.54	2.61	2.68	2.75	2.82	2.90
120	2.15	2.22	2.29	2.36	2.43	2.50	2.57	2.64	2.71	2.78	2.85
122	2.12	2.19	2.25	2.32	2.39	2.46	2.53	2.60	2.66	2.73	2.80
124	2.08	2.15	2.22	2.28	2.35	2.42	2.49	2.55	2.62	2.69	2.76
126	2.05	2.12	2.18	2.25	2.31	2.38	2.45	2.51	2.58	2.65	2.71
128	2.02	2.08	2.15	2.21	2.28	2.34	2.41	2.47	2.54	2.60	2.67
130	1.99	2.05	2.12	2.18	2.24	2.31	2.37	2.44	2.50	2.56	2.63
134	1.93	1.99	2.05	2.11	2.18	2.24	2.30	2.36	2.43	2.49	2.55
136	1.90	1.96	2.02	2.08	2.14	2.21	2.27	2.33	2.39	2.45	2.51
140	1.85	1.90	1.96	2.02	2.08	2.14	2.20	2.26	2.32	2.38	2.44
144	1.79	1.85	1.91	1.97	2.03	2.08	2.14	2.20	2.26	2.31	2.37
146	1.77	1.83	1.88	1.94	2.00	2.05	2.11	2.17	2.23	2.28	2.34
150	1.72	1.78	1.83	1.89	1.94	2.00	2.06	2.11	2.17	2.22	2.28
154	1.68	1.73	1.79	1.84	1.89	1.95	2.00	2.06	2.11	2.16	2.22
156	1.66	1.71	1.76	1.82	1.87	1.92	1.98	2.03	2.08	2.14	2.19
160	1.61	1.67	1.72	1.77	1.82	1.87	1.93	1.98	2.03	2.08	2.14
164	1.58	1.63	1.68	1.73	1.78	1.83	1.88	1.93	1.98	2.03	2.08
166	1.56	1.61	1.66	1.71	1.76	1.81	1.86	1.91	1.96	2.01	2.06
170	1.52	1.57	1.62	1.67	1.72	1.76	1.81	1.86	1.91	1.96	2.01
174	1.48	1.54	1.58	1.63	1.68	1.72	1.77	1.82	1.87	1.92	1.96
176	1.47	1.52	1.56	1.61	1.66	1.70	1.75	1.80	1.85	1.89	1.94
180	1.44	1.48	1.53	1.57	1.62	1.67	1.71	1.76	1.81	1.85	1.90

VARIOUS RECIPES OF PROVED PRACTICAL VALUE

(E. W. Thomas)

MIXTURE FOR REMOVING OIL FROM CLOTH:

For a 50-gallon Mixture:

Put in a barrel 10 pails boiling water. Then dissolve 11 bars Ivory Soap in one pail of boiling water and add to the barrel. Then add 2½ to 3 pints of Silicate of Soda, also 5 lbs. of Tetra Chloride of Carbon.

Mix thoroughly, stir well, and bring contents to 50-gallon quantity.

STENCIL INK:

2 oz. Bi-Chromate of Potash.
2 oz. Gum Arabic.
1½ oz. Yellow Prussiate of Potash.

Mix and pulverize well and add 1 qt. of warm water, dissolve thoroughly and add 1 qt. of Liquid Extract Logwood. Make up the gallon by additional cold water. Keep in *corked* earthen jug.

Another Mixture

10 lbs. Gum Arabic, 8 qts. Warm Water.
10 qts. Black Pigment (Heller & Merz) = 5 gallons Ink.

ULTRAMARINE BLUE for 1 gallon Mixture:

Use 2 lbs. Blue.
3 oz. Potato Starch.
1 oz. British Gum.
Boil.

SIZING MIXTURES

For Lawn Size:

Potato Starch	180 Pounds
Tallow	10 "
T. Gum	15 "
Water	200 "

Boil 2½ hours

For A Medium Size:

Globe Pearl Starch	160 Pounds
Tallow or Substitute	25 "
Water	200 Gallons

Boil 2½ to 3 hours

For 64 x 64 Sheeting:

Corn Starch	150 Pounds
Compound	12 "
Tallow	3 "
Water	200 Gallons

Boil 2 hours

For 80 x 80 Sheeting:

Corn Starch	165 Pounds
Compound	14 "
Tallow	4 "

Boil 2 hours

APPROXIMATE POWER REQUIRED FOR COTTON MACHINERY

	H. P.
Self Feeding Openers	3
Combined Self Feeding Opener and Single Beater Breaker Lapper	9
40″ Single Beater Intermediate or Finisher Lapper	$4\frac{1}{2}$
Two-Beater Intermediate or Finisher Lapper	$7\frac{1}{2}$
Waste Picker	3
Thread Extractor with Condenser	$1\frac{1}{2}$
40″ Revolving Flat Card, Production 450 lbs. per week	$\frac{3}{4}$
" " " " " 750 " " "	1
" " " " " 1000 " " "	$1\frac{1}{4}$
Sliver Lap Machine	$\frac{1}{2}$
Ribbon Lap Machine	1
Comber 6-head	$\frac{1}{2}$
" 8-head	$\frac{2}{3}$
Drawing Frames 5 to 6 delvs. per	1
Slubber Frames 40 to 45 spdls. per	1
Intermediate Frames 55 to 60 spdls. per	1
Roving Frames 70 to 85 " "	1
Jack or Fine Roving Frames 100 spdls. per	1
Ring Spinning Frames:	
6000 r. p. m. (Filling) 110 spdls. per	1
7000 r. p. m. " 100 " "	1
8000 r. p. m. (Warp) 90 " "	1
8500 r. p. m. " 80 " "	1
9000 r. p. m. " 70 " "	1
1000 r. p. m. " 60 " "	1
Twisters 30 to 50 spdls. per	1
Cone Winders 65 drums "	1
Spoolers 200 to 300 spdls."	1
Warpers	$\frac{1}{4}$
Ball Warpers	$\frac{1}{2}$
Slasher	2
Looms:	
32″ and 36″	$\frac{1}{4}$
40″ and 48″	$\frac{1}{3}$
80″	$\frac{1}{2}$
92″ to 108″	$\frac{3}{4}$ to 1
Brusher	1
Brusher and Shearer	3
Cloth Folder	$\frac{1}{3}$ to $\frac{1}{2}$

NOTE.—The above figures are only approximate but they give a fair average of the power required to drive the various machines. The speed production and many other conditions affect the power consumed. For Friction of Belting and Shafting add from 18 to 22 per cent.

MAXIMUM LIMITS OF HUMIDITY OF THE ATMOSPHERE AT GIVEN TEMPERATURES

Cotton Cloth Factories Act, 1889.

Dry Bulb Readings.	Wet Bulb Readings.	Grains of Moisture per cubic foot of Air.	Percentage of Humidity Saturation = 100.	Dry Bulb Readings.	Wet Bulb Readings.	Grains of Moisture per cubic foot of Air.	Percentage of Humidity Saturation = 100.
35°	33°	1·9	80	68°	66°	6·6	88
36	34	2·0	82	69	67	6·9	88
37	35	2·1	83	70	68	7·1	88
38	36	2·2	83	71	68·5	7·1	85·5
39	37	2·3	84	72	69	7·1	84
40	38	2·4	84	73	70	7·4	84
41	39	2·5	84	74	70·5	7·4	81·5
42	40	2·6	85	75	71·5	7·65	81·5
43	41	2·7	84	76	72	7·7	79
44	42	2·8	84	77	73	8·0	79
45	43	2·9	85	78	73·5	8·0	77
46	44	3·1	86	79	74·5	8·25	77·5
47	45	3·2	86	80	75·5	8·55	77·5
48	46	3·3	86	81	76	8·6	76
49	47	3·4	86	82	76·5	8·65	74
50	48	3·5	86	83	77·5	8·85	74
51	49	3·6	86	84	78	8·9	72
52	50	3·8	86	85	79	9·2	72
53	51	3·9	86	86	80	9·5	72
54	52	4·1	86	87	80·5	9·55	71
55	53	4·2	87	88	81·5	9·9	71
56	54	4·4	87	89	82·5	10·25	71
57	55	4·5	87	90	83	10·3	69
58	56	4·7	87	91	83·5	10·35	68
59	57	4·9	88	92	84·5	10·7	68
60	58	5·1	88	93	85·5	11·0	68
61	59	5·2	88	94	86	11·1	66
62	60	5·4	88	95	87	11·5	66
63	61	5·6	88	96	88	11·8	66
64	62	5·8	88	97	88·5	11·9	65·5
65	63	6·0	88	98	89	12·0	64

STANDARDS RELATING TO CAPACITY, EFFICIENCY, AND ECONOMY OF POWER PLANT APPARATUS

(From Report of Power Test Committee A. S. M. E.)

DEFINITION OF UNITS

One British thermal unit (B. t. u.) or heat unit as herein used = 1/180 of the heat required to raise 1 lb. of water from 32 deg. to 212 deg. Fahr.

One unit of evaporation (U. E.) = heat required to evaporate 1 lb. of water at 212 deg. into steam at the same temperature = 970.4 British thermal units.

Mechanical equivalent of heat: 1 B. t. u. = 777.54 ft.-lb., or 1 ft.-lb. = 0.0012861 B. t. u.[1].

One pound (of force) = the force exerted by gravity on 1 lb. of matter where the acceleration due to gravity is 32.1740 ft. per second per second; that is (very nearly) the force of gravity on 1 lb. of matter at latitude 45 deg. at the sea level.

One horsepower = 33,000 ft.-lb. per min. = 550 ft.-lb. per sec.
= 1,980,000 ft.-lb. per hour.
= 2,546.5 B. t. u. per hour = 42.44 B. t. u. per min.
= 745.7 watts= 0.7457 kilowatt.

One kilowatt = 1000 watts = 1.3410 h. p. = 3,415 B. t. u. per hour.
= 737.56 ft.-lb. per sec.

One kilowatt-hour = 1.3410 h. p. hr. = 2,655,200 ft.-lb.

One atmosphere = 760 mm. or 29.921 in. of mercury at 32 deg. Fahr.
= 29.951 in. of mercury at 62 deg. Fahr.
= 14.6963 lb. per sq. in.

Absolute temperature (deg. Fahr.) = temperature by thermometer plus 460 deg.

[1] Based on the following accepted values:

1 mean calorie = 4.1834 x 107 dyne-centimeters (Marks & Davis)

1 dyne = $\frac{1 \text{ gram}}{980.665}$ (International Standard). 1 cm. = $\frac{0.3937}{12}$ ft.

1 B. t. u. = 1.8 lb.-deg. cent. 1 gram = 0.002204622 lb.

1 watt = 10.7 dyne-centimeters per sec. = 0.73756046 ft.-lb. per sec.

1 h. p. = 550 ft.-lb. per sec. $\frac{550}{0.73756046}$ = 745.702 watts.

STEAM

THE TEMPERATURE OF STEAM in contact with water depends upon the pressure under which it is generated. At the ordinary atmospheric pressure (14.7 pounds per square inch) its temperature is 212 deg. Fahr. As the pressure is increased, as by the steam being generated in a closed vessel, its temperature, and that of the water in its presence, increases.

SATURATED STEAM is steam of the temperature due to its pressure—not superheated.

SUPERHEATED STEAM is steam heated to a temperature above that due to its pressure.

DRY STEAM is steam which contains no moisture. It may be either saturated or superheated.

WET STEAM is steam containing intermingled moisture, mist or spray. It has the same temperature as dry saturated steam of the same pressure. Water introduced into the presence of superheated steam will flash into vapor until the temperature of the steam is reduced to that due to its pressure. Water in the presence of saturated steam has the same temperature as the steam. Should cold water be introduced, lowering the temperature of the whole mass, some of the steam will be condensed, reducing the pressure and temperature of the remainder, until an equilibrium is established.

GASEOUS STEAM—When saturated steam is superheated or surcharged with heat, it advances from the condition of saturation into that of gaseity. The gaseous state is only arrived at by considerably elevating the temperature, supposing the pressure remains the same. Steam thus sufficiently superheated is known as gaseous steam or steam gas.

Copied from "Kent."

PROPERTIES OF SATURATED STEAM

(Kent)

Gauge Pressure Lbs. per Sq. In.	Absolute Pressure Lbs. per Sq. In.	Temperature Fahrenheit	Total Heat Above 32° F.		Latent Heat = L = H − h Heat Units	Relative Volume Vol. of Water at 39°F. = 1.	Volume Cu. Ft. in One Lb. Steam	Weight of One Cu. Ft. Steam Lb.
			In the Water h Heat Units	In the Steam H Heat Units				
–	1.0	102.1	70.09	1,113.1	1,043.0	20,623.0	334.23	.00299
–	2.0	126.3	94.44	1,120.5	1,026.0	10.730.0	173.23	.00577
–	3.0	141.6	109.9	1,125.1	1,015.3	7,325.0	117.98	.00848
–	4.0	153.1	121.4	1,128.6	1,007.2	5,588.0	89.80	.01112
–	5.0	162.3	130.7	1,131.4	1,000.7	4,530.0	72.50	.01373
	6.0	170.1	138.6	1,133.8	995.2	3,816.0	61.10	.01631
–	7.0	176.9	145.4	1,135.9	990.5	3,302.0	53.00	.01887
–	8.0	182.9	151.5	1,137.7	986.2	2,912.0	46.60	.02140
–	9.0	188.3	156.9	1,139.4	982.4	2.607.0	41.82	.02391
	10.0	193.2	161.9	1,140.9	979.0	2,361.0	37.80	.02641
–	11.0	197.8	166.5	1,142.3	975.8	2,159.0	34.61	.02889
–	12.0	202.0	170.7	1,143.5	972.8	1,990.0	31.90	.03136
–	13.0	205.9	174.7	1,144.7	970.0	1,846.0	29.58	.03381
	14.0	209.6	178.4	1,145.9	967.4	1,721.0	27.59	.03625
	14.7	212.0	180.9	1,146.6	965.7	1,646.0	26.36	.03794
0.304	15.0	213.0	181.9	1,146.9	965.0	1,614.0	25.87	.03868
5.3	20.0	227.9	197.0	1,151.5	954.4	1,231.0	19.72	.05070
10.3	25.0	240.0	209.3	1,155.1	945.8	998.4	15.99	.06253
15.3	30.0	250.2	219.7	1,158.3	938.9	841.3	13.48	.07420
20.3	35.0	259.2	228.8	1,161.0	932.2	727.9	11.66	.08576
25.3	40.0	267.1	236.9	1,163.4	926.5	642.0	10.28	.09721
30.3	45.0	274.3	244.3	1,165.6	921.3	574.7	9.21	.1086
35.3	50.0	280.9	251.0	1,167.6	916.6	520.5	8.34	.1198
40.3	55.0	286.9	257.2	1,169.4	912.3	475.9	7.63	.1311
45.3	60.0	292.5	262.9	1,171.2	908.2	438.5	7.03	.1422
50.3	65.0	297.8	268.3	1,172.8	904.5	406.6	6.53	.1533
55.3	70.0	302.7	273.4	1,174.3	900.9	379.3	6.09	.1643
60.3	75.0	307.4	278.2	1,175.7	897.5	355.5	5.71	.1753
65.3	80.0	311.8	282.7	1,177.0	894.3	334.5	5.37	.1862
70.3	85.0	316.0	287.0	1,178.3	891.3	315.9	5.07	.1971
75.3	90.0	320.0	291.2	1,179.6	888.4	299.4	4.81	.2080
80.3	95.0	323.9	295.1	1,180.7	885.6	284.5	4.57	.2188
85.3	100.0	327.6	298.9	1,181.8	882.9	271.1	4.36	.2296
90.3	105.0	331.1	302.6	1,182.9	880.3	258.9	4.16	.2403
95.3	110.0	334.5	306.1	1,184.0	877.9	247.8	3.98	.2510
100.3	115.0	337.8	309.5	1,185.0	875.5	237.6	3.82	.2617
105.3	120.0	341.0	312.8	1,185.9	873.2	228.3	3.67	.2724
110.3	125.0	344.1	316.0	1.186.9	870.9	219.6	3.53	.2830
115.3	130.0	347.1	319.1	1,187.8	868.7	211.6	3.41	.2936
120.3	135.0	350.0	322.1	1,188.7	866.6	204.2	3.29	.3042
125.3	140.0	352.8	325.0	1,189.5	864.6	197.3	3.18	.3147
130.3	145.0	355.5	327.8	1,190.4	862.6	190.9	3.07	.3253
135.3	150.0	358.2	330.6	1,191.2	860.6	184.9	2.98	.3358
140.3	155.0	360.7	333.2	1,192.0	858.7	179.2	2.89	.3463
145.3	160.0	363.3	335.9	1,192.7	856.9	173.9	2.80	.3567
150.3	165.0	365.7	338.4	1,193.5	855.1	169.0	2.72	.3671
155.3	170.0	368.2	340.9	1,194.2	853.3	164.3	2.65	.3775
160.3	175.0	370.5	343.4	1,194.9	851.6	159.8	2.58	.3879
165.3	180.0	372.8	345.8	1,195.7	849.9	155.6	2.51	.3983
170.3	185.0	375.1	348.1	1,196.3	848.2	151.6	2.45	.4087
175.3	190.0	377.3	350.4	1,197.0	846.6	147.8	2.39	.4191
180.3	195.0	379.5	352.7	1,197.7	845.0	144.2	2.33	.4296
185.3	200.0	381.6	354.9	1,198.3	843.4	140.8	2.27	.4400
190.3	205.0	383.7	357.1	1,199.0	841.9	137.5	2.22	.4503
195.3	210.0	385.7	359.2	1,199.6	840.4	134.5	2.17	.4605
200.3	215.0	387.7	361.3	1,200.2	838.9	131.5	2.12	.4707
205.3	220.0	389.7	362.2	1,200.8	838.6	128.7	2.06	.4852
215.3	230.0	393.6	366.2	1,202.0	835.8	123.3	1.98	.5061
225.3	240.0	397.3	370.0	1,203.1	833.1	118.5	1.90	.5270
235.3	250.0	400.9	373.8	1,204.2	830.5	114.0	1.83	.5478

STANDARDS OF EFFICIENCY AND ECONOMY

(American Society of Mechanical Engineers)

a. Boilers	Relation between B. t. u. absorbed by boiler per lb. of dry coal and calorific value of 1 lb. dry coal. (Efficiency of boiler furnace and grate) Relation between B. t. u. absorbed by boiler per lb. of combustible burned and calorific value of 1 lb. combustible. (Efficiency based on combustible.)

NOTE:—The term "steam" in this table means dry steam, either saturated or superheated as the case may be. If it contains moisture, the moisture is to be deducted. If superheated, no correction is to be made.

b. Reciprocating Steam Engines	(1) B. t. u. per i. h. p.-hr. (2) B. t. u. per brake h. p.-hr. (3) Ft.-lb. of net work per B. t. u. (4) Thermal efficiency referred to i. h. p. (5) Thermal efficiency referred to br. h. p. (6) Rankine cycle ratio referred to i. h. p. (7) Rankine cycle ratio referred to br. h. p. (8) Lb. of steam per i. h. p.-hr. (9) Lb. of steam per br. h. p.-hr.
c. Steam Turbines	(1) B. t. u. per br. h. p.-hr. (2) Ft.-lb. of net work per B. t. u. (3) Thermal efficiency. (4) Rankine cycle ratio. (5) Lb. of steam per br. h. p.-hr.
d. Turbo-generators (including engine-driven generators)	(1) B. t. u. per kw.-hr. (2) Ft.-lb. of net work per B. t. u. (3) Thermal efficiency. (4) Rankine cycle ratio. (5) Lb. of steam per kw.-hr.
e. Pumping Engines	(1) Ft.-lb. of work per million B. t. u. (2) Ft.-lb. of net work per B. t. u.
f. Compressors, Blowers, and Fans	(1) B. t. u. per net air h. p.-hr. (2) Ft.-lb. of net work per B. t. u. (3) Lb. of steam per net air h. p.-hr. (4) Lb. of steam per 1000 cu. ft. of free air compressed to 100 lb. gage pressure reduced to atmospheric temperature.
g. Complete Steam Power Plants:	
Plants in General	(1) Lb. of coal as fired per i. h. p.-hr. (2) Lb. of steam per i. h. p.-hr. (3) Heat units in fuel consumed per i. h. p.-hr.
Electric Plants	(1) Lb. of coal as fired per kw.-hr. (2) Lb. of steam per kw.-hr. (3) Heat units in fuel consumed per kw.-hr.
Pumping Plants	(1) Ft.-lb. of work per million B. t. u. (2) Lb. of coal as fired per water h. p.-hr.
Air Machinery Plants	(1) Lb. of coal as fired per air h. p.-hr. (2) Lb. of steam per air h. p.-hr.

STANDARDS OF EFFICIENCY AND ECONOMY

(American Society of Mechanical Engineers)

h. Locomotives	(1) Lb. of coal as fired per i. h. p.-hr. (2) Lb. of coal as fired per dyn. h. p.-hr. (3) Lb. of steam per i. h. p.-hr. (4) Lb. of steam per dyn. h. p.-hr. (5) Lb. of coal as fired per ton-mile.
i. Gas Producers	Relation between B. t. u. of the gas output per lb. of dry fuel and calorific value of 1 lb. of dry fuel.
j. Gas and Oil Engines	(1) B. t. u. per i. h. p.-hr. (2) B. t. u. per br. h. p.-hr. (3) Ft.-lb. of net work per B. t. u. (4) Thermal efficiency referred to *i.* h. p. (5) Thermal efficiency referred to br. h. p. (6) Lb. of oil per i. h. p.-hr. (7) Lb. of oil per br. h. p.-hr. (8) Cu. ft. of dry gas at 60 deg. and 30 in. per i. h. p.-hr. (9) Cu. ft. of dry gas at 60 deg. and 30 in. per br. h. p.-hr.
k. Waterwheels	(1) Relation between brake h. p. and potential h. p. of total water used. (2) Relation between kw.-hr. delivered and potential kw.-hr.

NOTE: The i. h. p. and brake h. p. in this table refer to that of the main engine, turbine, or waterwheel, and the kw. to the power measured at the generator terminals, not including exciter output.

The "calorific value" of fuel is the number of heat units developed in completely burning one pound of the fuel, including the heat contained in any water vapor formed through burning the hydrogen component. This is the higher heat value and not the so-called net or available heat value, in obtaining which the latent heat in the vapor thus formed is deducted.

The English Standards used in the preceding tables may be converted to Metric Units (and vice versa) by the use of the following factors:

FACTORS FOR CONVERTING ENGLISH UNITS TO METRIC UNITS.

One inch	= 2.54	centimeters.
One foot	= 0.3048	meter.
One sq. in.	= 6.4516	sq. cm.
One cu. ft.	= 0.028317	cubic meter.
One U. S. gallon	= 3.7854	liters.
One pound	= 0.453592	kilogram.
One lb. per sq. in.	= 0.070307	kg. per sq. cm.
One foot-pound	= 0.13826	meter-kilogram.
One horsepower	= 1.0139	cheval-vapeur.
One B. t. u.	= 0.252	kilogram-calorie.
One deg. Fahr.	= 0.55556	deg. centigrade.

FACTORS FOR CONVERTING METRIC UNITS TO ENGLISH UNITS.

One centimeter	= 0.3937	inch.
One meter	= 3.28083	feet.
One sq. cm.	= 0.155	sq. in.
One cubic meter	= 35.3145	cu. ft.
One liter	= 0.26417	U. S. gallon.
One kilogram	= 2.20462	pounds.
One kg. per sq. cm.	= 14.223	lb. per sq. in.
One meter-kilogram	= 7.233	foot-pounds.
One cheval-vapeur	= 0.98629	horsepower.
One kilogram-calorie	= 3.9683	B. t. u.
One deg. centigrade	= 1.8	deg. Fahr.

STANDARD UNITS OF CAPACITY

a. Boilers*	One pound of water evaporated into dry steam from and at 212 deg. per hour.
b. Reciprocating Steam Engines	One indicated horsepower developed in the main cylinders. One brake horsepower delivered by the main shaft.
c. Steam Turbines	One brake horsepower delivered by the main shaft.
d. Turbo-generators (including engine-driven generators)	One kilowatt delivered at the generator terminals,† not including kilowatts used by exciter.‡
e. Pumping Machinery	One gallon of water discharged to the force main in 24 hr. One gallon of water discharged per min.§ One water horsepower delivered to the force main, based on the total head including suction.
f. Compressors, Blowers, and Fans	One cu. ft. of air at 62 deg. and 30 in.¶ One air horsepower.
g. Locomotives	One indicated horsepower developed in the main cylinders. One dynamometer horsepower delivered to the draw-bar.
h. Gas Producers	One pound of dry fuel of given quality consumed per hour. One cu. ft. per hour of dry gas having a stated quality at 60 deg. and 30 in.
i. Gas and Oil Engines	One brake horsepower delivered by the main shaft. One indicated horsepower developed in the engine cylinder.
j. Waterwheels	One brake horsepower delivered by the main shaft. One kilowatt delivered at the generator terminals,† not including kilowatts used by exciter.‡

*A subsidiary unit which may be used for stationary boilers is a "Boiler Horsepower," or 34½ lb. of water evaporated from and at 212 deg. per hour, *i.e.*, from water at 212 deg. into steam at the same temperature. The unit called "Myriawatt" has been suggested by some engineers as a unit of boiler capacity. It is 2 per cent. greater than the "Boiler Horsepower" and is equivalent to 34,150 heat units per hour, the "Boiler Horsepower" being 33,479 heat units per hour.

†If switchboard instruments are used for the electrical measurements, correction should be made for the drop in voltage between generator and switchboard, unless the drop is so small as to be negligible.

‡If the exciter current is taken from an outside source the kw. thus supplied, including field rheostat fosses, are to be deducted from the total output. Likewise the kw. used by separately driven ventilating fan.

§This unit applies to small pumps and some classes of large-sized pumps.

¶30 in. mercury barometer refers in round numbers to a standard atmosphere at 62 deg. In exact figures the standard atmosphere is 29.951 in. of mercury at 62 deg.

BOILER EFFICIENCY TABLE

BASED ON EVAPORATION FROM AND AT 212° F.

B. T. U. Per Lb. Coal	50% Efficiency		55% Efficiency		60% Efficiency		65% Efficiency		68% Efficiency		70% Efficiency		72% Efficiency		74% Efficiency		76% Efficiency		78% Efficiency		80% Efficiency	
	Evap. Per Lb. Coal	Lbs. Coal Per H. P. Hour	Evap. Per Lb. Coal	Lbs. Coal Per H. P. Hour	Evap. Per Lb. Coal	Lbs. Coal Per H. P. Hour	Evap. Per Lb. Coal	Lbs. Coal Per H. P. Hour	Evap. Per Lb. Coal	Lbs. Coal Per H. P. Hour	Evap. Per Lb. Coal	Lbs. Coal Per H. P. Hour	Evap. Per Lb. Coal	Lbs. Coal Per H. P. Hour	Evap. Per Lb. Coal	Lbs. Coal Per H. P. Hour	Evap. Per Lb. Coal	Lbs. Coal Per H. P. Hour	Evap. Per Lb. Coal	Lbs. Coal Per H. P. Hour	Evap. Per Lb. Coal	Lbs. Coal Per. H. P. Hour
7500	3.8	9.0	4.2	8.2	4.6	7.5	5.0	6.8	5.2	6.6	5.4	6.4	5.5	6.3	5.7	6.1	5.9	5.8	6.0	5.7	6.2	5.5
8000	4.1	8.4	4.5	7.6	4.9	7.0	5.3	6.5	5.6	6.2	5.7	6.0	5.9	5.9	6.1	5.7	6.3	5.5	6.4	5.4	6.6	5.2
8500	4.4	7.8	4.8	7.1	5.2	6.6	5.7	6.0	6.0	5.8	6.1	5.6	6.3	5.5	6.5	5.3	6.7	5.2	6.8	5.1	7.0	4.9
9000	4.6	7.5	5.1	6.7	5.5	6.2	6.0	5.7	6.3	5.4	6.5	5.3	6.7	5.2	6.9	5.0	7.1	4.9	7.2	4.8	7.4	4.6
9500	4.9	7.0	5.4	6.3	5.9	5.8	6.3	5.4	6.6	5.2	6.8	5.0	7.0	4.9	7.2	4.8	7.4	4.7	7.6	4.5	7.8	4.4
10000	5.1	6.7	5.6	6.1	6.2	5.5	6.7	5.1	7.0	4.9	7.2	4.7	7.4	4.7	7.6	4.5	7.8	4.4	8.0	4.3	8.2	4.2
10500	5.4	6.3	5.9	5.8	6.5	5.3	7.1	4.8	7.3	4.7	7.6	4.5	7.8	4.4	8.0	4.3	8.2	4.2	8.4	4.1	8.6	4.0
11000	5.6	6.1	6.2	5.5	6.8	5.0	7.4	4.6	7.7	4.4	7.9	4.3	8.1	4.2	8.4	4.1	8.6	4.0	8.8	3.9	9.1	3.7
11500	5.9	5.8	6.5	5.3	7.1	4.8	7.7	4.4	8.0	4.3	8.3	4.1	8.5	4.0	8.8	3.9	9.0	3.8	9.2	3.7	9.5	3.6
12000	6.2	5.5	6.8	5.0	7.4	4.6	8.0	4.3	8.4	4.1	8.7	4.0	8.9	3.9	9.2	3.7	9.4	3.7	9.6	3.6	9.9	3.4
12500	6.4	5.3	7.1	4.8	7.7	4.4	8.4	4.1	8.8	3.9	9.0	3.8	9.3	3.7	9.5	3.6	9.8	3.5	10.0	3.5	10.3	3.3
13000	6.7	5.1	7.4	4.6	8.0	4.3	8.7	3.9	9.1	3.7	9.4	3.6	9.6	3.6	9.9	3.5	10.2	3.4	10.4	3.3	10.7	3.2
13500	6.9	5.0	7.6	4.5	8.3	4.1	9.0	3.8	9.5	3.6	9.7	3.5	10.0	3.5	10.3	3.3	10.6	3.2	10.9	3.2	11.1	3.1
14000	7.2	4.7	7.9	4.3	8.6	4.0	9.4	3.6	9.8	3.5	10.1	3.4	10.4	3.3	10.7	3.2	11.0	3.1	11.3	3.1	11.5	3.0
14500	7.5	4.6	8.2	4.2	9.0	3.8	9.7	3.5	10.2	3.3	10.5	3.2	10.7	3.2	11.1	3.1	11.4	3.0	11.7	2.9	12.0	2.8
15000	7.7	4.5	8.5	4.0	9.3	3.7	10.0	3.3	10.5	3.2	10.9	3.1	11.1	3.1	11.4	3.0	11.8	2.9	12.1	2.8	12.5	2.7

Compiled by The Under-Feed Stoker Company of America

COAL COST OF STEAM

Cost of Coal Per Ton of 2000 Lbs.	Evaporation Per Pound of Coal from and at 212° F.																				
	5.00	5.25	5.50	5.75	6.00	6.25	6.50	6.75	7.00	7.25	7.50	7.75	8.00	8.25	8.50	8.75	9.00	9.25	9.50	9.75	10.00
	Cost in Cents to Evaporate 1000 Pounds Water from and at 212° F.																				
$1.00	[1]0.0	9.53	9.10	8.7	8.33	8.00	7.70	7.42	7.14	6.90	6.66	6.45	6.25	6.06	5.88	5.73	5.56	5.40	5.27	5.13	5.00
1.25	12.5	11.9	11.3	10.8	10.4	10.0	9.62	9.25	8.93	8.62	8.33	8.07	7.82	7.56	7.35	7.15	6.95	6.75	6.57	6.42	6.25
1.50	15.0	14.3	13.7	13.1	12.5	12.0	11.5	11.1	10.7	10.4	10.0	9.68	9.38	9.10	8.82	8.57	8.35	8.12	7.90	7.70	7.50
1.75	17.5	16.6	15.9	15.2	14.6	14.0	13.5	13.0	12.5	12.1	11.7	11.3	10.9	10.6	10.3	10.0	9.73	9.47	9.22	8.98	8.75
2.00	20.0	19.0	18.2	17.4	16.7	16.0	15.4	14.8	14.3	13.8	13.3	12.9	12.5	12.1	11.7	11.4	11.1	10.8	10.5	10.3	10.0
2.25	22.5	21.4	20.4	19.6	18.8	18.0	17.3	16.7	16.1	15.5	15.0	14.5	14.1	13.7	13.2	12.9	12.5	12.2	11.8	11.5	11.2
2.50	25.0	23.8	22.6	21.6	20.8	20.0	19.2	18.5	17.9	17.2	16.7	16.1	15.6	15.1	14.7	14.3	13.9	13.5	13.1	12.8	12.5
2.75	27.5	26.2	25.0	23.9	23.0	22.0	21.2	20.3	19.6	19.0	18.3	17.7	17.2	16.6	16.2	15.7	15.3	14.9	14.5	14.1	13.7
3.00	30.0	28.6	27.4	26.2	25.0	24.0	23.0	22.2	21.4	20.8	20.0	19.4	18.8	18.2	17.6	17.1	16.7	16.2	15.8	15.4	15.0
3.25	32.5	31.0	29.6	28.3	27.1	26.0	25.0	24.1	23.2	22.4	21.7	21.0	20.3	19.7	19.1	18.6	18.1	17.6	17.1	16.7	16.3
3.50	35.0	33.2	31.8	30.4	29.2	28.0	27.0	26.0	25.0	24.2	23.4	22.6	21.8	21.2	20.6	20.0	19.5	18.9	18.4	18.0	17.5
3.75	37.5	35.6	34.1	32.6	31.3	30.0	28.9	27.8	26.8	25.9	25.0	24.2	23.4	22.7	22.0	21.4	20.8	20.3	19.7	19.2	18.7
4.00	40.0	38.0	36.4	34.8	33.4	32.0	30.8	29.6	28.6	27.6	26.6	25.8	25.0	24.2	23.4	22.8	22.2	21.6	21.0	20.6	20.0
4.25	42.5	40.0	38.6	37.0	35.4	34.0	32.7	31.5	30.4	29.3	28.3	27.4	26.6	25.8	25.0	24.3	23.6	23.0	22.4	21.8	21.2
4.50	45.0	42.8	40.8	39.2	37.6	36.0	34.6	33.4	32.2	31.0	30.0	29.0	28.2	27.4	26.4	25.8	25.0	24.4	23.6	23.0	22.4
4.75	47.5	45.3	43.2	41.3	39.6	38.0	36.5	35.2	33.9	32.8	31.7	30.6	29.7	28.8	28.0	27.2	26.4	25.7	25.0	24.4	23.8
5.00	50.0	47.6	45.2	43.2	41.6	40.0	38.4	37.0	35.8	34.4	33.4	32.2	31.2	30.2	29.4	28.6	27.8	27.0	26.2	25.6	25.0

Compiled by The Under-Feed Stoker Company, of America.

CAPACITY OF PUMPS AT 100 FEET PISTON SPEED

UNION STEAM PUMP CO.

A travel of one hundred feet piston speed per minute is considered practical and is accepted as standard speed. Slow speed for boiler feeding is recommended. No set rule can be given to cover all conditions. In Fire Pumps, where the largest quantity of water is required, the speed may exceed two hundred feet per minute.

THEORETICAL CAPACITY OF PUMPS AT 100 FEET SPEED OF PISTON OR PLUNGER

Diameter of Pump or Plunger in Inches	U. S. Gallons Per			Diameter of Pump or Plunger in Inches	U. S. Gallons Per		
	Minute	Hour	24 Hours		Minute	Hour	24 Hours
1	4.07	244.7	5,875	14¼	828	49,704	1,192,896
1¼	6.37	382.5	9,180	14½	858	51,468	1,235,232
1½	9.18	550.8	13,219	14¾	887	53,256	1,278,144
1¾	12.49	749	17,992	15	918	55,070	1,321,915
2	16.31	979	23,500	15¼	949	56,928	1,366,272
2¼	20.6	1,239	28,180	15½	980	58,800	1,411,200
2½	25.5	1,530	36,720	15¾	1,012	60,720	1,457,280
2¾	30.8	1,851	44,424	16	1,044	62,668	1,504,046
3	36.7	2,203	52,878	16¼	1,077	64,638	1,551,312
3¼	43.1	2,586	62,064	16½	1,110	66,642	1,599,408
3½	49.9	2,998	71,971	16¾	1,144	68,676	1,648,224
3¾	57.3	3,442	82,619	17	1,179	70,752	1,698,048
4	65.2	3,916	94,002	17¼	1,214	72,840	1,748,160
4¼	73.7	4,422	106,128	17½	1,249	74,964	1,799,136
4½	82.6	4,957	118,971	17¾	1,285	77,124	1,850,976
4¾	92	5,523	132,552	18	1,322	79,314	1,903,550
5	102	6,120	146,880	18¼	1,359	81,528	1,956,672
5¼	112	6,745	161,934	18½	1,396	83,778	2,010,672
5½	123	7,404	177,696	18¾	1,434	86,060	2,065,449
5¾	134	8,093	194,248	19	1,473	88,368	2,120,832
6	146	8,812	211,511	19¼	1,511	90,660	2,175,840
6¼	159	9,562	229,500	19½	1,552	93,120	2,234,880
6½	172	10,344	248,256	19¾	1,590	95,400	2,289,600
6¾	185	11,152	267,660	20	1,632	97,920	2,350,080
7	200	11,995	287,884	20½	1,673	100,380	2,409,120
7¼	214	12,867	308,808	20½	1,714	102,840	2,468,160
7½	229	13,769	330,478	20¾	1,756	105,396	2,529,504
7¾	245	14,700	352,300	21	1,799	107,952	2,590,848
8	261	15,667	376,011	21¼	1,842	110,538	2,652,912
8¼	277	16,660	399,852	21½	1,886	113,154	2,715,696
8½	294	17,688	424,512	21¾	1,930	115,800	2,779,200
8¾	312	18,741	449,978	22	1,974	118,482	2,843,568
9	330	19,828	475,887	22¼	2,020	121,194	2,908,656
9¼	349	20,944	502,668	22½	2,065	123,924	2,974,176
9½	368	22,092	530,208	22¾	2,111	126,696	3,040,704
9¾	388	23,280	558,720	23	2,158	129,492	3,107,808
10	408	24,480	587,518	23¼	2,205	132,324	3,175,776
10¼	428	25,716	617,184	23½	2,253	135,186	3,244,464
10½	449	26,989	647,789	23¾	2,301	138,078	3,313,872
10¾	471	28,290	678,960	24	2,349	140,958	3,382,992
11	493	29,616	710,784	24¼	2,399	143,952	3,454,848
11¼	516	30,986	743,677	24½	2,449	146,958	3,526,992
11½	539	32,374	776,993	24¾	2,499	149,952	3,598,848
11¾	564	33,795	811,080	25	2,550	152,994	3,671,856
12	587	35,251	846,046	25½	2,653	159,179	3,820,300
12¼	612	36,735	881,640	26	2,758	165,484	3,971,630
12½	637	38,250	918,000	26½	2,865	171,908	4,125,800
12¾	663	39,816	955,584	27	2,974	178,457	4,282,967
13	689	41,370	992,880	27½	3,085	185,130	4,443,125
13¼	716	42,972	1,031,328	28	3,199	191,922	4,606,125
13½	743	44,610	1,070,640	28½	3,314	198,838	4,772,118
13¾	771	46,278	1,110,672	29	3,431	205,876	4,941,028
14	799	47,980	1,151,536	30	3,672	220,320	5,287,675

For practical purposes, deduct ten per cent., as no pump will deliver its theoretical capacity.

SIZE OF CHIMNEYS FOR STEAM-BOILERS

(KENT'S FORMULA) H. P. = 3.33 (A − 0.6 $\sqrt{A}$) $\sqrt{H}$. (Assuming 1 H. P. = 5 lbs. of coal burned per hour)

Diam. Inches	Area sq. ft. A	Effective Area $E = A - 0.6\sqrt{A}$ Sq. Ft.	Height of Chimney in Feet														Equivalent Square Chimney. Side of Square
			50	60	70	80	90	100	110	125	150	175	200	225	250	275	300	
			Commercial Horse-Power of Boiler														
18	1.77	.97	23	25	27	29	–	–	–	–	–	–	–	–	–	–	–	16
21	2.41	1.47	35	38	41	44	–	–	–	–	–	–	–	–	–	–	–	19
24	3.14	2.08	49	54	58	62	66	–	–	–	–	–	–	–	–	–	–	22
27	3.98	2.78	65	72	78	83	88	–	–	–	–	–	–	–	–	–	–	24
30	4.91	3.58	84	92	100	107	113	119	–	–	–	–	–	–	–	–	–	27
33	5.94	4.48	–	115	125	133	141	149	156	–	–	–	–	–	–	–	–	30
36	7.07	5.47	–	141	152	163	173	182	191	204	–	–	–	–	–	–	–	32
39	8.30	6.57	–	–	183	196	208	219	229	245	–	–	–	–	–	–	–	35
42	9.62	7.76	–	–	216	231	245	258	271	289	316	–	–	–	–	–	–	38
48	12.57	10.44	–	–	–	311	330	348	365	389	426	–	–	–	–	–	–	43
54	15.90	13.51	–	–	–	–	427	449	472	503	551	595	–	–	–	–	–	48
60	19.64	16.98	–	–	–	–	536	565	593	632	692	748	–	–	–	–	–	54
66	23.76	20.83	–	–	–	–	–	694	728	776	849	918	981	–	–	–	–	59
72	28.27	25.08	–	–	–	–	–	835	876	934	1023	1105	1181	1253	–	–	–	64
78	33.18	29.73	–	–	–	–	–	–	1038	1107	1212	1310	1400	1485	1565	–	–	70
84	38.48	34.76	–	–	–	–	–	–	1214	1294	1418	1531	1637	1736	1830	1919	2005	75
90	44.18	40.19	–	–	–	–	–	–	–	1496	1639	1770	1893	2008	2116	2219	2318	80
96	50.27	46.01	–	–	–	–	–	–	–	1713	1876	2027	2167	2298	2423	2541	2654	86
102	56.75	52.23	–	–	–	–	–	–	–	1944	2130	2300	2459	2609	2750	2884	3012	91
108	63.62	58.83	–	–	–	–	–	–	–	2190	2392	2592	2770	2930	3098	3249	3393	96
114	70.88	65.83	–	–	–	–	–	–	–	–	2685	2900	3100	3288	3466	3635	3797	101
120	78.54	73.22	–	–	–	–	–	–	–	–	2986	3226	3448	3657	3855	4043	4223	107
132	95.03	89.18	–	–	–	–	–	–	–	–	3637	3929	4200	4455	4690	4925	5144	117
144	113.10	106.72	–	–	–	–	–	–	–	–	4352	4701	5026	5331	5613	5893	6155	128
156	132.73	125.82	–	–	–	–	–	–	–	–	–	5542	5925	6285	6624	6948	7256	138
168	153.94	146.50	–	–	–	–	–	–	–	–	–	6454	6899	7318	7713	8090	8449	149
180	176.71	168.74	–	–	–	–	–	–	–	–	–	7433	7946	8429	8884	9318	9732	160
192	201.06	192.56	–	–	–	–	–	–	–	–	–	–	9068	8619	10138	10633	11105	170
204	226.98	217.94	–	–	–	–	–	–	–	–	–	–	10263	10885	11475	12035	12569	180
216	254.47	244.90	–	–	–	–	–	–	–	–	–	–	–	12233	12894	13523	14123	191
228	283.53	273.53	–	–	–	–	–	–	–	–	–	–	–	–	14396	15099	15768	202
240	314.16	303.53	–	–	–	–	–	–	–	–	–	–	–	–	–	16761	17505	213

For pounds of coal burned per hour for any given size of chimney, multiply the figures in the table by 5.
For Low Grade Bituminous Coal in Middle and Western States, we recommend chimneys 25 per cent. larger than shown on this Table.

STACK SIZES FOR OIL FUEL

(Marks)

Stack Diam. Ins.	Height in Ft. above Boiler-Room Floor					
	80	90	100	120	140	160
33	161	206	233	270	306	315
36	208	253	295	331	363	387
39	251	303	343	399	488	467
42	295	359	403	474	521	557
48	399	486	551	645	713	760
54	519	634	720	847	933	1000
60	657	800	913	1073	1193	1280
66	813	993	1133	1333	1480	1593
72	980	1206	1373	1620	1807	1940
84	1373	1587	1933	2293	2560	2767
96	1833	2260	2587	3087	3453	3740
108	2367	2920	3347	4000	4483	4867
120	3060	3660	4207	5040	5660	6160

Figures represent nominal rated h. p.; sizes as given are good for 50 per cent. overloads. Based on centrally located stacks, short direct flues and ordinary operating efficiencies.

RELATIVE VALUES OF COAL AND OIL FUEL

Gross Boiler Efficiency with Oil Fuel	Net Boiler Efficiency* with Oil Fuel	Net Evaporation Lb. from and at 212 Deg. Fahr. per Lb. of Oil.	Water Evaporated from and at 212 Deg. Fahr. per Pound of Coal							
			5	6	7	8	9	10	11	12
			Pounds of Oil Equal to 1 lb. of Coal							
73	71	13.54	0.3693	0.4431	0.5170	0.5909	0.6647	0.7386	0.8124	0.8863
74	72	13.73	0.3642	0.4370	0.5099	0.5827	0.6556	0.7283	0.8011	0.8740
75	73	13.92	0.3592	0.4310	0.5029	0.5747	0.6466	0.7184	0.7903	0.8621
76	74	14.11	0.3544	0.4253	0.4961	0.5670	0.6378	0.7087	0.7796	0.8505
77	75	14.30	0.3497	0.4196	0.4895	0.5594	0.6294	0.6993	0.7692	0.8392
78	76	14.49	0.3451	0.4141	0.4831	0.5521	0.6211	0.6901	0.7591	0.8281
79	77	14.68	0.3406	0.4087	0.4768	0.5450	0.6131	0.6812	0.7493	0.8174
80	78	14.87	0.3363	0.4035	0.4708	0.5380	0.6053	0.6725	0.7398	0.8070
81	79	15.06	0.3320	0.3984	0.4648	0.5312	0.5976	0.6640	0.7304	0.7968
82	80	15.25	0.3279	0.3934	0.4590	0.5246	0.5902	0.6557	0.7213	0.7869
83	81	15.44	0.3238	0.3886	0.4534	0.5181	0.5829	0.6447	0.7125	0.7772

*Net efficiency = gross efficiency less 2 per cent. for steam used in atomizing oil.
Heat value of oil = 18500 B. T. U.

NAMES AND SIZES OF COAL

ANTHRACITE OR "HARD"

The ordinary sizes and designations of "Domestic" hard coals are:

Names of Sizes	*Will pass through*	*Will not pass through*
"Pea"	$\frac{3}{4}$ inch mesh	$\frac{1}{2}$ inch mesh
"Chestnut," or "Nut"	$1\frac{1}{4}$ inch mesh	$\frac{3}{4}$ inch mesh
"Stove," or "Range"	$1\frac{3}{4}$ inch mesh	$1\frac{1}{4}$ inch mesh
"Egg"—In the East	$2\frac{1}{2}$ inch mesh	$1\frac{3}{4}$ inch mesh
"Large Egg"—Chicago	4 inch mesh	$2\frac{3}{4}$ inch mesh
"Small Egg"—Chicago	$2\frac{3}{4}$ inch mesh	2 inch mesh
"Broken," or "Grate"	4 inch mesh	$2\frac{1}{2}$ inch mesh

BITUMINOUS OR "SOFT"

For "Domestic" soft coals there are no uniform names and sizes; but they are marketed in the various states under about these classes:

"Screenings" usually smallest sizes.
"Duff" goes through $\frac{1}{8}$ in. screen.
"No. 3 Nut" goes through $1\frac{1}{4}$ in. screen, over $\frac{3}{4}$ in. screen.
"No. 2 Nut" goes through 2 in. screen, over $1\frac{1}{4}$ in. screen.
"No. 1 Domestic Nut" goes through 3 in. screen, over $1\frac{1}{2}$ or 2 in. screen.
"No. 4 Washed" goes through $\frac{3}{4}$ in. screen, over $\frac{1}{4}$ in. screen.
"No. 3 Washed Chestnut" goes through $1\frac{1}{4}$ in. screen, over $\frac{3}{4}$ in. screen.
"No. 2 Washed Stove" goes through 2 in. screen, over $1\frac{1}{4}$ in. screen.
"No. 1 Washed Egg" goes through 3 in. screen, over 2 in. screen.
"No. 3 Roller Screened Nut" goes through $1\frac{1}{2}$ in. screen, over 1 in. screen.
"No. 2 Roller Screened Nut" goes through 2 in. screen, over $1\frac{1}{2}$ in. screen.
"No. 1 Roller Screened Nut" goes through $3\frac{1}{2}$ in. screen, over 2 in. screen.
"Egg" goes through 6 in. screen, over 3 in. screen.
"Lump" or "Block" goes through 6 in. screen, or over.
"Run-of-mine" in fine and large lumps.

Pocahontas Smokeless: Generally sized as: "Nut," "Egg," "Lump," and "Mine-Run."

Cannel Coal: For fireplaces, "Hand Picked Lump"; for stoves, "Egg."

Domestic By-product Coke: "Egg," 3 in.—$2\frac{1}{2}$ in.
"Large Stove," $2\frac{1}{2}$ in.—2 in. "Small Stove," 2 in.—$1\frac{1}{2}$ in.
"Nut," $1\frac{1}{2}$ in.—$\frac{3}{4}$ in. "Pea," $\frac{3}{4}$ in.—$\frac{1}{2}$ in.

APPROXIMATE CLASSIFICATION OF IMPURITIES FOUND IN FEED WATERS, THEIR EFFECT AND ORDINARY METHODS OF RELIEF

IMPURITY	NATURE OF DIFFICULTY	ORDINARY METHOD OF OVERCOMING OR RELIEVING
Sediment, mud, etc. . .	Incrustation	Settling tanks, filtration, blowing down.
Readily soluble salts . .	Incrustation	Blowing down.
Bicarbonates of lime, magnesia, etc.	Incrustation	Heating feed. Treatment by addition of lime or of lime and soda. Barium carbonate.
Sulphate of lime	Incrustation	Treatment by addition of soda. Barium carbonate.
Chloride and sulphate of magnesium	Corrosion .	Treatment by addition of carbonate of soda.
Acid	Corrosion .	Alkali.
Dissolved carbonic acid and oxygen	Corrosion .	Heating feed. Keeping air from feed. Addition of caustic soda or slacked lime.
Grease	Corrosion .	Filter. Iron alum as coagulant. Neutralization by carbonate of soda. Use of best hydrocarbon oils.
Organic matter	Corrosion .	Filter. Use of coagulant.
Organic matter (sewage)	Priming . .	Settling tanks. Filter in connection with coagulant.
Carbonate of soda in large quantities	Priming . .	Barium carbonate. New feed supply. If from treatment, change.

ROPE TRANSMISSION OF POWER

The general advantage or disadvantage of rope drives as against leather belting may be stated briefly as follows:

Belting is advantageously employed in power transmission whenever the distance between the driveway and the follower is small; also whenever high speeds and small pulleys are used; and again when it is necessary to shift the power from a fast to a loose pulley. Small belts are so easily applied and under proper conditions are so easily cared for they are not looked upon as a serious factor. When large power is to be transmitted, necessitating great widths of belts, we find the cost growing to be more and more a matter of importance owing to the scarcity of the best quality of leather necessary in the making of wide belts and the consequently increasing price of hides.

The advantages claimed by those who favor rope transmission are as follows:

All belting requires exact alignment. It also has a large percentage of slip and therefore a constant loss of power. There is also a loss of power in friction or in the bending of the belt. The belting is noisy in operation and often produces electrical disturbances which are sometimes very objectionable. By the use of idle pulleys, the power may be transmitted at any angle but for this purpose, or for a long distance transmission, it does not compare with the rope drive.

Rope transmission, on the other hand (and in general in employing this term Fibrous ropes are referred to) possesses many advantages, some singularly and others in connection with other methods in power transmission, some of which may be stated as follows:

First. The distance to which power may be transmitted in mill practice is practically unlimited.

Second. The amount of power which may be transmitted is also practically unlimited.

Third. The lightness of the rope, its elasticity and slackness between pulleys takes up inequalities in power and load, thus producing an evenness in running which exists in no other system of power transmission.

Fourth. Rope drives are noiseless, a fact due to the flexibility and lubrication of the rope and to the air passage in the grooves between it and the pulleys.

Fifth. No electrical disturbance is produced.

Sixth. Practical security is attained against shutdowns by failure of the ropes, for, before failing, ropes stretch excessively, but gradually, thus giving notice that repairs are to be made at some convenient time.

Seventh. Precise alignment is not essential and by properly placed idle pulleys power may be transmitted without difficulty in any direction.

Eighth. Except for short distances it is the cheapest method for transmitting power; in first cost, in installation, in renewal and also in maintenance.

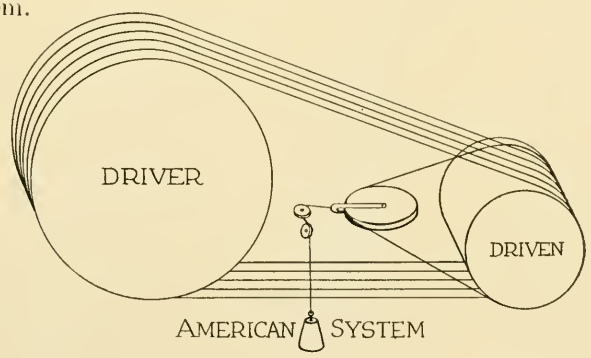
Many so called disadvantages in rope driving are no more serious than are similar ones peculiar to belt transmission, and the difficulty of securing to the ropes the correct speed and tension, the proper splicing of them, the design and workmanship of the pulleys (especially the surface finish and form of the grooves)—all of these important details are not really difficult to secure and a little experience with the system renders their attainment comparatively easy.

By the majority of Engineers and Manufacturers the rope drive is not considered as practicable for short drives and small powers as the belt drive.

Electricity as a means of transmitting power has great merit and with the improvements increasing in number almost daily it is becoming a most formidable rival of all other methods. However, in ordinary mill practice of today it cannot replace entirely the belt and rope transmission, whatever it may do in years to come.

TWO SYSTEMS OF ROPE DRIVING

Two general systems of rope driving are recognized; one, the multiple, called the "English" system, where a number of independent ropes run side by side in the grooves of the pulleys, and the other, the continuous or "American" system, where one rope is wound around the sheaves several times. In the latter system it is necessary by some device to conduct the rope from the delivering to the receiving groove, also to take up the slack and maintain the desired tension. This is accomplished by the tension pulley to and from which the rope is led, either directly or by one or more idlers. The cut below illustrates this latter system.



For the English system it is claimed that the drive has the utmost security against break-downs because of the extreme unlikelihood of more than one rope's ever giving away at any one time, and that this may be repaired when convenient; also, that power may be more easily transferred to the several floors of a mill, and again, that the amount of power transmitted may be more readily increased by installing additional ropes (this latter assumes, of course, that neither the engine nor the driver's sheaves are already loaded to their limit).

Against this system it is claimed that, in consequence of unequal stretching, and of the difficulty of obtaining ropes of the same diameter, and of making them the same length by splicing, all are under a different velocity and tension, causing slipping, wear, loss of power, etc.; that many splices, or weak points, are introduced, there being one for each rope, and finally that a lot of ropes all sagging differently is very unsightly.

For the American system it is claimed that by the use of the tightener pulley, the rope throughout is subjected to the same tension; that only one splice is introduced in the rope; that the rope is of the same size, and that no differential driving exists.

In answer to this it is stated that the tightener pulley does not always produce the same strain throughout the rope (see paper before American Society Civil Engineers, by Miller); that the presence of the tightener as an extra appliance is a disadvantage, and that when the rope does give away the whole plant must be shut down. Besides those mentioned there are other little pros and cons for both systems which do not settle the question either way.

Though many large plants designed with the continuous system exist, yet practice based on experience seems to favor the multiple system for large and short distance transmissions, such as in cable roads and electric power plants, etc., while in long distance drives it probably inclines to the former.

TABLE I.

DIAMETER OF SMALLEST PERMISSIBLE PULLEY TO BE USED WITH MANILA ROPE OF GIVEN SIZE, WEIGHT ETC., AND REVOLUTIONS PER MINUTE OBTAINED WITH ROPE-VELOCITY OF 90 FEET PER SECOND

(The American Manufacturing Co.)

d	Ultimate Strength	Working Strain	Diameter of Smallest Pulley	Maximum Number of Revolutions per Minute
$\frac{3}{4}$	3,375 lbs.	112.5	27 inches	760
1	6,000 "	200.0	36 "	570
$1\frac{1}{4}$	9,375 "	312.5	45 "	460
$1\frac{1}{2}$	13,500 "	450.0	54 "	380
$1\frac{3}{4}$	18,375 "	612.5	63 "	330
2	24,000 "	800.0	72 "	290

TABLE II.

HORSE-POWER TRANSMITTED BY DIFFERENT SIZED ROPES AT VARIOUS SPEEDS

Diam. Rope, In.	Velocity, Feet per Minute										
	1000	1500	2000	2500	3000	3500	4000	4500	5000	5500	6000
$\frac{3}{4}$	2.3	3.3	4.3	5.2	6.0	6.6	7.2	7.3	7.4	7.3	6.9
$\frac{7}{8}$	3.0	4.5	5.9	7.0	8.2	9.0	9.6	9.8	10.0	9.6	9.0
1	4.0	5.9	7.7	9.2	10.6	11.8	12.7	12.9	13.0	12.7	12.0
$1\frac{1}{8}$	5.0	7.5	9.7	11.6	13.5	14.9	16.0	16.3	16.7	16.5	15.3
$1\frac{1}{4}$	6.3	9.1	12.0	14.3	16.7	18.5	20.0	20.2	20.7	20.1	18.9
$1\frac{3}{8}$	7.5	10.8	14.4	17.4	20.0	22.1	23.7	24.5	24.6	24.0	22.3
$1\frac{1}{2}$	9.0	13.5	17.4	20.7	23.0	26.3	28.7	29.0	29.5	28.6	26.7
$1\frac{5}{8}$	10.5	15.5	20.1	24.3	27.9	30.8	32.9	34.1	34.3	33.3	31.0
$1\frac{3}{4}$	12.3	18.0	23.6	28.2	32.7	36.4	38.5	39.4	40.5	38.7	36.0
2	16.0	23.2	30.6	36.8	42.5	46.7	50.0	51.7	52.8	50.6	47.3
$2\frac{1}{4}$	20.0	29.6	38.6	46.6	53.6	59.2	63.6	65.8	66.3	64.4	60.3
$2\frac{1}{2}$	25.0	36.6	47.7	57.5	66.0	71.2	78.0	80.0	81.0	79.0	73.8

TRANSMISSION ROPES

Ropes for transmission purposes are made of different materials, such as rawhide, flax, hemp, cotton, manila, sisal and coir. Rawhide ropes are excellent for some purposes but their excellent qualities being unproportionate to their great cost they are not economical. Ropes of flax, for a similar reason, are not used to any extent. Cotton ropes, formerly much used particularly in spinning districts of England, being relatively weak compared to manila are more expensive for equal horse power transmitted, and so are disappearing in the larger drives. They have, however, a degree of lightness, elasticity and flexibility not possessed by manila ropes, which gives them a wide range of applicability in the smaller machine appliances. Ropes of sisal and coir are not used to any extent for transmission purposes, yet $1\frac{3}{4}$-inch ropes of sisal, in drives that without repairs have been in constant use for over two years, show them to possess in no small degree the qualities required of good transmission rope. Excepting rawhide, all these fibers are vegetable in origin, and, speaking generally, they bear the popular name of the plant from which they are obtained. Coir, however, is the name given to the fiber from the husk of the cocoanut, and sisal and manila are the names of ports in Yucatan and

the Philippine Islands, from which countries respectively these fibers are obtained. The plant from which manila is procured is called *abaca* and is similar to the banana tree. The fiber forms the outside covering of the leaf stalk and is separated therefrom by a mechanical process called "stripping"; manila fiber is from 8 to 12 feet in length. The butts, or lower portions only of the best manila fiber are utilized in making transmission rope, thus giving it the necessary strength and durability. The tensile strength of manila fiber is remarkable and according to tests made at the Watertown Arsenal is as high as 30,000 pounds per square inch—more than half that of wrought iron. This great strength, however, is shown only when the fibers are subjected to a straightaway or longitudinal strain; transversely, owing to their cellular formation, the fibers are relatively weak. It is for this reason that in transmitting power with manila ropes, large pulleys are necessary, for the smaller the pulley the greater the crossswise strain upon the strands (and consequently upon the fibers) and the greater the friction.

It is for this reason that in manufacturing Manila Transmission ropes great care should be taken to put such proportion of twist in the yarns and strands as is best calculated to render it the least vulnerable to crosswise strains, and to frictional wear and tear consequent upon the rubbing of the strands against each other in passing over the pulleys. Therefore, the twisting should be somewhat less in transmission than in other ropes; thus causing less friction and abrasion between the strands and between the pulleys and the rope; also more flexibility and consequently a better grip on the pulley. Transmission rope is usually laid with four strands around a core which makes it more nearly circular, of greater cross section and strength, more compact, and affords a greater bearing surface on the sheaves. Good quality 3 strand rope is sometimes used for transmission purposes with excellent results, but owing to the lesser area of contact, more abrasion occurs, lessening its durability, and as its strength is considerably less for a given diameter than that of a 4 strand rope the latter is generally preferred.

In bending the rope to any extent the surface of the strands rub together and wear occurs. To limit this in some measure the diameter of the pulley over which the rope plays is made as large as possible (certainly not less than 30 and preferably 40 times the diameter of the rope). To lessen the amount of abrasion the rope should be treated with a preparation that will serve as a lubricant to the strands (and core, if 4 stranded) and thus not only prevent, in a large measure, the internal wear that is sure to occur, but to fortify it against destructive

agencies, such as steam, gases and dampness or wet weather, if used out of doors, and help it retain its flexibility, durability and strength.

In a drive, next in importance to the rope itself, are the pulleys or sheaves. These are grooved to receive the ropes and are made of metal or of wood. Owing to the form of the grooves those of metal are heavier than are pulleys of equal diameter used in belting, which, however, is not a positive disadvantage because it helps to produce the uniform running noticeable in rope drives.

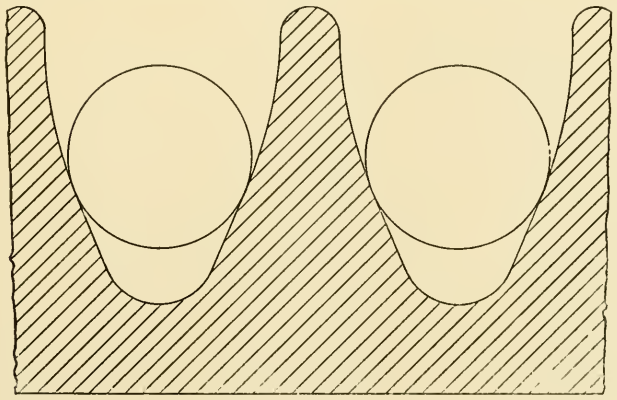
It is very necessary that rope pulleys be made true, for if imperfect their vibrations produce swaying of the ropes, and possibly friction between them, causing extra wear besides loss of power. The surface finish of the grooves must also be perfectly smooth or the rope will be subjected to excessive wear from abrasion.

Rope drives are sometimes substituted for systems of belting, and to utilize the belt pulleys, grooved segments are attached to the rim of the pulleys and the work on these must be of the same character as that required for rope sheaves.

The minimum diameter of the sheave for any size of rope has been given in Table I. It should be from 36 to 40 times the diameter of the rope, but if occasion makes it absolutely necessary it may possibly be made as small as 30, but not less.

The grooves of the rope pulley are a great factor in the success of a rope drive. They are made up of either straight or curved sides which approach at the bottom. Almost every kind of groove has been tried with more or less success, but practice for general work has selected the cross section as given below, with an angle of 45 degrees.

In rope driving, as is also the case in belt driving, the ropes should operate with the slack side uppermost, thus increasing the arc of contact and consequently the grip of the rope on the pulleys.



APPROXIMATE WEIGHTS AND STRENGTHS OF MANILA ROPE

(Mr. Hunt's Formula)

Nom. Diam., Inches	Circumference, Inches	Approx. Weight of 100 ft. of Rope, Lbs.	Breaking Strength, Lbs.
$\frac{3}{16}$	$\frac{9}{16}$	1.1	230
$\frac{1}{4}$	$\frac{3}{4}$	1.9	410
$\frac{5}{16}$	1	3.4	730
$\frac{3}{8}$	$1\frac{1}{8}$	4.4	920
$\frac{7}{16}$	$1\frac{1}{4}$	5.4	1,130
$\frac{1}{2}$	$1\frac{1}{2}$	7.7	1,630
$\frac{9}{16}$	$1\frac{3}{4}$	10.5	2,220
$\frac{5}{8}$	2	13.8	2,900
$\frac{3}{4}$	$2\frac{1}{4}$	17.4	3,660
$1\frac{3}{16}$	$2\frac{1}{2}$	21.5	4,530
$\frac{7}{8}$	$2\frac{3}{4}$	25.9	5,480
1	3	30.9	6,520
$1\frac{1}{16}$	$3\frac{1}{4}$	36.3	7,630
$1\frac{1}{8}$	$3\frac{1}{2}$	42.1	8,880
$1\frac{1}{4}$	$3\frac{3}{4}$	48.4	10,200
$1\frac{5}{16}$	4	55.0	11,600
$1\frac{3}{8}$	$4\frac{1}{4}$	60.4	13,100
$1\frac{1}{2}$	$4\frac{1}{2}$	69.6	14,600
$1\frac{9}{16}$	$4\frac{3}{4}$	77.5	16,300
$1\frac{5}{8}$	5	85.9	18,200
$1\frac{3}{4}$	$5\frac{1}{2}$	104.0	21,800
2	6	124.0	26,100
$2\frac{1}{8}$	$6\frac{1}{2}$	145.0	30,600
$2\frac{1}{4}$	7	168.0	35,500
$2\frac{1}{2}$	$7\frac{1}{2}$	193.0	40,800
$2\frac{5}{8}$	8	220.0	46,400
$2\frac{7}{8}$	$8\frac{1}{2}$	247.0	52,200
3	9	278.0	58,600
$3\frac{1}{8}$	$9\frac{1}{2}$	310.0	65,400
$3\frac{1}{4}$	10	344.0	72,600
$3\frac{1}{2}$	11	416.0	87,800
$3\frac{3}{4}$	12	495.0	104,300
$4\frac{1}{8}$	13	580.0	122,400
$4\frac{1}{2}$	14	670.0	142,000

SAFE LOADS IN THOUSANDS OF POUNDS

Hollow Cylindrical Cast Iron Columns.

Outside Diam., Inches	Thickness of Metal, Inches	Length of Columns in Feet							Sectional Area, Square Inches	Weight per Foot of Length of Columns, Lbs.
		8	10	12	14	16	18	20		
6	$\frac{1}{2}$	52.4	46.0	40.2	35.0	30.4	26.4	23.0	8.6	26.95
6	$\frac{3}{4}$	75.0	66.0	57.6	50.0	43.4	37.8	33.0	12.4	38.59
6	$\frac{7}{8}$	85.4	75.2	65.6	59.0	49.4	43.0	37.6	14.1	43.96
6	1	95.2	83.8	73.0	63.6	55.2	48.0	42.0	15.7	49.01
6	$1\frac{1}{8}$	104.4	92.0	80.2	69.6	60.4	52.6	46.0	17.2	53.76
7	$\frac{3}{4}$	95.4	86.2	77.0	68.6	60.8	53.8	47.8	14.7	45.96
7	1	122.2	110.4	98.6	87.6	77.8	68.8	61.2	18.9	58.90
7	$1\frac{1}{8}$	134.4	121.6	108.6	96.6	85.6	75.8	67.4	20.8	64.77
8	$\frac{3}{4}$	115.8	106.6	97.2	88.2	79.4	71.6	64.4	17.1	53.29
8	1	149.2	137.4	125.0	113.4	102.2	92.0	82.8	22.0	68.64
8	$1\frac{1}{4}$	179.8	165.6	151.0	136.8	123.4	111.0	99.8	26.5	82.71
9	$\frac{3}{4}$	136.2	127.2	117.8	108.4	99.2	90.4	82.4	19.4	60.65
9	1	176.0	164.6	152.4	140.0	128.2	116.8	106.4	25.1	78.40
9	$1\frac{1}{4}$	213.2	199.2	184.4	169.6	155.2	141.6	128.8	30.4	94.94
9	$1\frac{1}{2}$	247.6	231.4	214.2	197.0	180.2	164.4	149.6	35.3	110.26
9	$1\frac{3}{4}$	279.2	261.0	241.6	222.2	203.2	185.4	168.8	39.9	124.36
10	1	202.8	191.8	179.6	167.2	154.8	143.0	131.6	28.3	88.23
10	$1\frac{1}{4}$	246.6	233.0	218.2	203.2	188.2	173.6	159.8	34.4	107.23
10	$1\frac{1}{2}$	287.4	271.6	254.6	237.0	219.4	202.4	186.4	40.1	124.99
10	$1\frac{3}{4}$	325.4	307.6	288.2	268.2	248.4	229.2	211.0	45.4	141.65

Note: The above Table is based on the Gordon Formula $P = \frac{8000}{1 + \frac{l}{800\,d^2}}$

in which P = Allowable pressure per sq. in. of cross section.
l = Length of Column in inches.
d = Outside diameter in inches.

SAFE LOADS IN POUNDS FOR COLUMNS, ROUND AND SQUARE

DOUGLAS-FIR AND SPRUCE

(Kidder)

SIZE OF COLUMN IN INCHES	LENGTH OF COLUMN IN FEET								
	8	10	12	14	15	16	18	20	24
4 x 6	15,500	14,280	13,050						
5½ round	16,650	15,790	14,900	14,030					
6 x 6	25,704	24,480	23,256	22,032	21,420	20,808			
6 x 8	34,272	32,640	31,008	29,376	28,560	27,744			
6 x 10	42,840	40,800	37,760	36,720	35,700	34,680			
7½ round	32,740	31,540	30,340	29,140	28,540	27,940	26,740		
8 x 8	47,870	46,240	44,600	42,970	42,160	41,340	39,710		
8 x 10	59,840	57,800	55,760	53,720	52,700	51,680	49,640		
8 x 12	71,808	69,360	66,910	64,460	63,240	62,000	59,560		
9½ round	54,150	52,650	51,150	49,580	48,820	48,070	46,570		
10 x 10	85,000	78,800	72,760	70,720	69,700	68,680	66,640	64,600	
10 x 12	102,000	89,760	87,300	84,860	83,640	82,400	80,000	77,500	
10 x 14	119,000	104,700	101,860	99,000	97,580	96,150	93,300	90,400	
11½ round	88,290	79,100	77,250	75,400	74,470	73,550	71,700	69,850	66,160
12 x 12	122,400	110,160	107,700	105,260	104,040	102,800	100,360	97,920	93,000
14 x 14	166,600	166,600	149,450	146,600	145,180	143,760	140,900	138,080	132,400

LONG-LEAF YELLOW-PINE AND WHITE-OAK

SIZE OF COLUMN IN INCHES	LENGTH OF COLUMN IN FEET								
	8	10	12	14	15	16	18	20	24
4 x 6	18,200	16,800	15,360						
5½ round	19,590	18,760	17,550	16,500					
6 x 6	30,200	28,800	27,400	25,900	25,200	24,500			
6 x 8	40,300	38,400	36,500	34,600	33,600	32,600			
6 x 10	50,400	48,000	45,600	43,200	42,000	40,800			
7½ round	38,540	37,130	35,710	34,300	33,590	32,890			
8 x 8	64,000	54,400	52,500	50,600	49,600	48,600	46,700		
8 x 10	80,000	68,000	65,600	63,200	62,000	60,800	53,400		
8 x 12	96,000	81,600	78,700	76,800	74,400	73,000	70,100		
9½ round	70,900	61,970	60,190	58,350	57,429	56,580	54,800		
10 x 10	100,000	100,000	85,600	83,200	82,000	80,800	78,400	76,000	
10 x 12	120,000	120,000	102,700	99,800	98,400	97,000	94,100	91,200	
10 x 14	140,000	140,000	119,800	116,500	114,800	113,100	109,800	106,400	
11½ round	103,900	103,900	90,912	88,730	87,690	86,550	84,160	82,290	
12 x 12	144,000	144,000	144,000	123,800	122,400	121,000	118,100	115,200	109,440
14 x 14	196,000	196,000	196,000	196,000	170,900	169,100	165,800	162,400	155,800

STANDARD PIPE COLUMNS

Wrought-Iron Pipe makes a very good column for comparatively light loads.

The following table gives the safe load for the ordinary sizes of Standard Pipes used as columns, according to the New York building laws.

For Extra Strong and Double Extra Strong Pipe used as columns, the safe load will increase in the same proportion as the weight per foot.

LOADS IN TONS OF 2000 LBS.

Length, Ft.	Size of Pipe, In. 3	4	5	6	7	8	9	10	12
	Thickness, In. .216	.237	.258	.280	.301	.322	.342	.365	.375
20	–	0.49	16.74	25.12	34.04	43.94	54.66	67.94	87.62
18	–	10.95	18.34	26.85	35.90	45.93	56.78	70.20	89.94
16	6.27	12.42	19.93	28.58	37.76	47.92	58.89	72.46	92.26
14	7.61	13.88	21.52	30.31	39.62	49.90	61.01	74.71	94.57
13	8.27	14.61	22.32	31.17	40.55	50.90	62.06	75.84	95.73
12	8.94	15.34	23.12	32.04	41.48	51.89	63.12	76.97	96.89
11	9.61	16.07	23.91	32.90	42.41	52.89	64.18	78.10	98.05
10	10.27	16.81	24.71	33.77	43.34	53.88	65.23	79.22	99.21
9	10.94	17.54	25.51	34.63	44.27	54.88	66.29	80.35	100.37
8	11.60	18.27	26.30	35.50	45.20	55.87	67.35	81.48	101.53
7	12.27	19.00	27.10	36.36	46.13	56.87	68.40	82.61	102.69
6	12.94	19.73	27.90	37.23	47.06	57.86	69.46	83.74	103.85
5	13.60	20.46	28.69	38.09	47.99	58.86	70.52	84.86	105.00

WEIGHTS OF VARIOUS MATERIALS AND LOADS ON STORAGE WAREHOUSE FLOORS

Material Stored	Weights per Cu. Foot of Space, Pounds	With Height of Pile, Feet	Weights per Sq. Ft. of Floor, Pounds
Dry Goods, Cotton, Wool, etc.:			
Burlap, in bales	43	6	258
Coir Yarn, in bales	33	8	264
Cotton, in bales, compressed,	18	8	144
Cotton Bleached Goods, in cases	28	8	224
Cotton Flannel, in cases	12	8	96
Cotton Sheeting, in cases	23	8	184
Cotton Yarn, in cases	25	8	200
Excelsior, Compressed	19	8	152
Hemp, Italian, compressed	22	8	176
Hemp, Manila, compressed	30	8	240
Jute, compressed	41	8	328
Linen, Damask, in cases	50	5	250
Linen Goods, in cases	30	8	240
Linen Towels, in cases	40	6	240
Sisal, compressed	21	8	168
Tow, compressed	29	8	232
Wool, in bales, compressed	48	–	–
Wool, in bales, not compressed	13	8	104
Wool, Worsteds, in cases	27	8	216
Building Material:			
Cement, Natural	59	6	354
Cement, Portland	73	6	438
Lime and Plaster	53	5	265

STANDARD WEIGHTS AND THICKNESSES OF CAST-IRON BELL-AND-SPIGOT PIPE*

(U. S. Cast Iron Pipe & Foundry Co. — Based on specifications adopted by the American Society for Testing Materials, and by the American Water Works Association)

Nominal Inside Diam. Ins.	Approximate Laying Length. Ft.	Class A 100 Ft. Head 43 Lbs. Pressure			Class B 200 Ft. Head 86 Lbs. Pressure			Class C 300 Ft. Head 130 Lbs. Pressure			Class D 400 Ft. Head 173 Lbs. Pressure			Approximate Lbs. Lead per Joint 2 In. Thick	Approximate Lbs. Hemp per Joint.
		Thickness Ins.	Outside Diam. In.	Wt. Per Ft. Lb.	Thickness Ins.	Outside Diam. Ins.	Wt. Per Ft. Lb.	Thickness Ins.	Outside Diam. Ins.	Wt. Per Ft. Lb.	Thickness Ins.	Outside Diam. Ins.	Wt. Per Ft. Lb.		
3	12	0.38	3.80	13.0	0.42	3.84	16.2	0.45	3.90	17.1	0.48	3.96	18.0	6.0	0.18
4	12	0.42	4.80	20.0	0.45	5.00	21.7	0.48	5.00	23.3	0.52	5.00	25.0	7.5	0.21
6	12	0.44	6.90	30.8	0.48	7.10	33.3	0.51	7.10	35.8	0.55	7.10	38.3	10.3	0.31
8	12	0.46	9.05	42.9	0.51	9.05	47.5	0.56	9.30	52.1	0.60	9.30	55.8	13.3	0.44
10	12	0.50	11.10	57.1	0.57	11.10	63.8	0.62	11.40	70.8	0.68	11.40	76.7	16.0	0.53
12	12	0.54	13.20	72.5	0.62	13.20	82.1	0.68	13.50	91.7	0.75	13.50	100.0	19.0	0.61
14	12	0.57	15.30	89.6	0.66	15.30	103.0	0.74	15.70	117.0	0.82	15.70	129.0	22.0	0.81
16	12	0.60	17.40	108.0	0.70	17.40	125.0	0.80	17.80	144.0	0.89	17.80	158.0	30.0	0.94
18	12	0.64	19.50	129.0	0.75	19.50	150.0	0.87	19.90	175.0	0.96	19.90	192.0	33.8	1.00
20	12	0.67	21.60	150.0	0.80	21.60	175.0	0.92	22.10	208.0	1.03	22.10	229.0	37.0	1.25
24	12	0.76	25.80	204.0	0.89	25.80	233.0	1.04	26.30	279.0	1.16	26.30	307.0	44.0	1.50
30	12	0.88	31.70	292.0	1.03	32.00	333.0	1.20	32.40	400.0	1.37	32.70	450.0	54.3	2.06
36	12	0.99	38.00	392.0	1.15	38.30	454.0	1.36	38.70	546.0	1.58	39.20	625.0	64.8	3.00
42	12	1.10	44.20	513.0	1.28	44.50	592.0	1.54	45.10	717.0	1.78	45.60	825.0	75.3	3.62
48	12	1.26	50.50	667.0	1.42	50.80	750.0	1.71	51.40	908.0	1.96	52.00	1050.0	85.5	4.37
54	12	1.35	56.70	800.0	1.55	57.10	933.0	1.90	57.80	1140.0	2.23	58.40	1340.0	97.6	6.25
60	12	1.39	62.80	917.0	1.67	63.40	1100.0	2.00	64.20	1340.0	2.38	64.80	1580.0	108.0	8.25
72	12	1.62	75.30	1280.0	1.95	76.00	1550.0	2.39	76.90	1900.0	—	—	—	131.3	12.50
84	12	1.72	87.50	1630.0	2.22	88.50	2100.0	—	—	—	—	—	—	152.0	15.00

*All weights are approximate and include allowance for bell, proportionate allowance to be made for any variation.

WEIGHTS OF CAST-IRON PIPE FOR FIRE PROTECTION

(Class E of New England W. W. Assoc. Specifications)

For Pressure not exceeding 150 lbs.

Inside Diam. of Pipe (Inches)	Thickness of Shell (Inches)	Weight 12 Ft. Length Incl. Socket (Pounds)	Weight per Ft. Including Socket (Pounds)	Weight per Ft. Excluding Socket (Pounds)
4	.39	230	19	17
6	.46	380	32	29
8	.53	575	48	44
10	.60	810	67	64
12	.65	1040	87	82
14	.70	1310	109	103
16	.75	1600	133	125
18	.80	1910	159	148
20	.85	2260	188	176
24	.95	3000	250	234
30	1.10	4340	361	338
36	1.25	5900	492	460

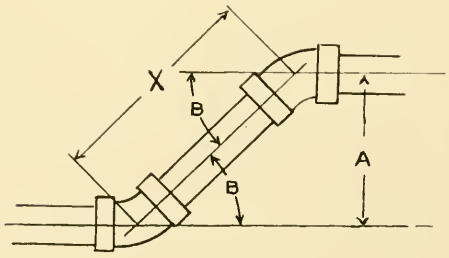
OFFSET FORMULA

Method for determining offset connections on Piping.

(The Valve World)

X (center to center) = A (offset) multiplied by constant.

B-angle	Constant
60 degrees	1.15
45 "	1.41
30 "	2.00
$22\frac{1}{2}$ "	2.61
$11\frac{1}{4}$ "	5.12
$5\frac{5}{8}$ "	10.20



WROUGHT IRON OR STEEL PIPE

TABLE OF DIMENSIONS

STANDARD FULL WEIGHT

(Walworth Manufacturing Co.)

Nominal Inside Diam. Inches.	Actual Outside Diameter. Inches.	Approx. Inside Diameter. Inches.	Approx. Thickness. Inches.	Length Pipe per Sq. Ft. of Outside Surface. Feet.	Inside Area. Inches.	Length of Pipe Containing One Cubic Foot. Feet.	Nominal Weight per Foot. Pounds.	No. of Threads per Inch of Screw.	Content in Gals. per Foot.
$\frac{1}{8}$	.405	.269	.068	9.44	.0568	2513.	.24	27	.0006
$\frac{1}{4}$	.54	.364	.088	7.075	.1041	1383.3	.42	18	.0026
$\frac{3}{8}$	.675	.493	.091	5.657	.1909	751.5	.56	18	.0057
$\frac{1}{2}$	.84	.622	.109	4.547	.3039	472.4	.85	14	.0102
$\frac{3}{4}$	1.05	.824	.113	3.637	.5333	270.	1.13	14	.023C
1	1.315	1.049	.133	2.903	.8609	166.9	1.68	$11\frac{1}{2}$	.04C8
$1\frac{1}{4}$	1.66	1.380	.140	2.301	1.496	96.25	2.28	$11\frac{1}{2}$	.0638
$1\frac{1}{2}$	1.90	1.610	.145	2.010	2.038	70.65	2.73	$11\frac{1}{2}$	.0918
2	2.375	2.067	.154	1.608	3.355	42.91	3.67	$11\frac{1}{2}$	.1632
$2\frac{1}{2}$	2.875	2.469	.203	1.328	4.780	30.11	5.81	8	.255C
3	3.50	3.068	.216	1.091	7.388	19.49	7.61	8	.3673
$3\frac{1}{2}$	4.0C	3.548	.226	.955	9.887	14.56	9.20	8	.4998
4	4.50	4.026	.237	.849	12.730	11.31	10.88	8	.6528
$4\frac{1}{2}$	5.CC	4.506	.247	.765	15.961	9.03	12.64	8	.8263
5	5.563	5.047	.258	.687	19.985	7.20	14.81	8	1.02C
6	6.625	6.065	.280	.577	28.886	4.98	19.18	8	1.469
7	7.625	7.023	.301	.501	38.743	3.72	23.76	8	1.990
8	8.625	8.071	.277	.444	51.187	2.81	25.00	8	2.659
8	8.625	7.981	.322	.444	50.021	2.88	28.80	8	2.611
9	9.625	8.941	.342	.397	62.722	2.29	34.18	8	3.300
10	10.75	10.136	.307	.355	80.715	1.78	35.00	8	4.1C0
10	10.75	10.020	.365	.355	78.822	1.82	41.13	8	4.081
12	12.75	12.090	.330	.299	114.875	1.25	45.00	8	5.967
12	12.75	12.000	.375	.299	113.098	1.270	50.76	8	5.87

DOUBLE EXTRA STRONG WROUGHT IRON OR STEEL PIPE

TABLE OF DIMENSIONS

Nominal Inside Diam. Inches.	Approx. Inside Diameter. Inches.	Actual Outside Diameter. Inches.	Approx. Thickness. Inches.	Length of Pipe per Square Foot of Outside Surface. Feet.	Inside Area. Square Inches.	Nominal Weight per Foot. Pounds.
$\frac{1}{2}$	.252	.84	.294	4.547	.047	1.71
$\frac{3}{4}$	.434	1.05	.308	3.637	.140	2.44
1	.599	1.315	.358	2.904	.271	3.65
$1\frac{1}{4}$	.896	1.66	.382	2.304	.615	5.21
$1\frac{1}{2}$	1.100	1.90	.400	2.010	.930	6.40
2	1.503	2.375	.436	1.608	1.744	9.02
$2\frac{1}{2}$	1.771	2.875	.552	1.328	2.419	13.69
3	2.300	3.50	.600	1.091	4.097	18.58
$3\frac{1}{2}$	2.728	4.00	.636	.955	5.794	22.85
4	3.152	4.50	.674	.849	7.724	27.54
$4\frac{1}{2}$	3.580	5.00	.710	.764	9.976	32.53
5	4.063	5.563	.750	.687	12.965	38.55
6	4.897	6.625	.864	.577	18.665	53.16
7	5.875	7.625	.875	.501	27.109	63.07
8	6.875	8.625	.875	.443	37.122	72.42

BURSTING TESTS OF COMMERCIAL WROUGHT IRON PIPE

There are no established standards for mill tests on wrought iron and steel pipe, but different manufacturers have their own schedules. The following table is given by The National Tube Company and contains results of tests made by them:

Wrought Pipe	Sizes, In.	Testing Pressure Lb. per Sq. In.
Standard butt-welded	$\frac{1}{8}$ to 3	700 to 800
Standard lap-welded	$1\frac{1}{2}$ to 15	600 to 1000
Extra strong butt-welded	$\frac{1}{8}$ to 3	700 to 1500
Extra strong lap-welded	$1\frac{1}{2}$ to 15	1000 to 2500
Double extra strong butt-welded	$\frac{1}{2}$ to $2\frac{1}{2}$	700 to 2200
Double extra strong lap-welded	$1\frac{1}{2}$ to 8	2000 to 3000

It must be understood that these tests are made for the purpose of discovering possible defects and the pressures given are in no way allowable working pressures.

LINEAR EXPANSION OF PIPES

The theoretical expansion of 100 ft. of iron or steel pipe carrying steam of various pressures and temperatures, based on an outside temperature of 32 degree Fahr., is as follows:

Gage pressure lbs. per sq. in.	30	100	125	150	175	200	Superheated steam				
Temperature of steam, deg. Fahr.	274	338	353	366	377	388	420	500	550	600	650
Expansion of 100 ft. of pipe, in.	2.03	2.72	2.89	3.05	3.19	3.31	3.73	4.77	5.48	6.23	7.03

The linear expansion of 100 ft. of cast iron, wrought iron, steel, brass, or copper pipe under various temperatures is given in the following Table:

The expansion for a pipe of any length between any two given temperatures is found by taking the difference in length at these temperatures, dividing by 100 and multiplying by the length of the pipe in feet.

LINEAR EXPANSION OF PIPES
(Increase of length of 100 Ft. of Pipe, in inches)

Temp. Deg. Fahr.	Cast Iron	Wrought Iron	Steel	Brass and Copper	Temp. Deg. Fahr.	Cast Iron	Wrought Iron	Steel	Brass and Copper
0	0.00	0.00	0.00	00.0	450	3.89	4.28	4.08	6.18
50	0.36	0.40	0.38	0.57	475	4.20	4.62	4.41	6.68
100	0.72	0.79	0.76	1.11	500	4.45	4.90	4.67	7.06
125	0.88	0.97	0.92	1.40	525	4.75	5.22	4.99	7.55
150	1.10	1.21	1.15	1.75	550	5.05	5.55	5.30	8.03
175	1.28	1.41	1.34	2.04	575	5.36	5.90	5.63	8.52
200	1.50	1.65	1.57	2.38	600	5.70	6.26	5.98	9.06
225	1.70	1.87	1.78	2.70	625	6.05	6.65	6.35	9.62
250	1.90	2.09	1.99	3.02	650	6.40	7.05	6.71	10.18
275	2.15	2.36	2.26	3.42	675	6.78	7.46	7.12	10.78
300	2.35	2.58	2.47	3.74	700	7.15	7.86	7.50	11.37
325	2.60	2.86	2.73	4.13	725	7.58	8.33	7.96	12.06
350	2.80	3.08	2.94	4.45	750	7.96	8.75	8.36	12.66
375	3.15	3.46	3.31	5.01	775	8.42	9.26	8.84	13.38
400	3.30	3.63	3.46	5.24	800	8.87	9.76	9.31	14.10
425	3.68	4.05	3.86	5.85					

EQUALIZATION OF PIPE AREAS

(Babcock and Wilcox)

* Diam. of Pipes, Ins.	Number of Smaller Pipes Equivalent to One Larger Pipe					
	¾ In.	1 In.	1½ In.	2 In.	3 In.	4 In.
½	2.27	4.88	15.8	31.7	96.9	205
¾	1	2.05	6.9	14	42.5	90.4
1	–	1	3.5	6.8	20.9	44.1
1½	–	–	1	1.3	6.1	13
2	–	–	–	1	3.1	6.5
2½	–	–	–	–	1.8	3.87
3	–	–	–	–	1	2.12
4	–	–	–	–	–	1
5						
6						
7						
8						

* Diam. of Pipes, Ins.	Number of Smaller Pipes Equivalent to One Larger Pipe					
	5 In.	6 In.	7 In.	8 In.	9 In.	10 In.
½	377	620	918	–	–	–
¾	166	273	405	569	779	–
1	81.1	133	198	278	380	536
1½	23.8	39.2	58.1	81.7	112	157
2	11.9	19.6	29.0	40.8	55.8	78.5
2½	7.1	11.7	17.4	24.4	33.4	47.0
3	3.9	6.4	9.5	13.3	20.9	23.7
4	1.8	3	4.5	6.3	8.6	12.1
5	1	1.6	2.4	3.4	4.7	6.6
6	–	1	1.5	2.1	2.8	4.0
7	–	–	1	1.4	1.9	2.7
8	–	–	–	1	1.3	1.9

* Nominal diameters standard steam- and gas-pipes.

EXAMPLE

To find number of 2-inch pipes which will deliver as much fluid as one 5-inch pipe: In column headed 5, and opposite 2 read 11.9, which is the equivalent number of 2-inch pipes.

WEIGHTS AND MEASURES

TROY WEIGHT

24 grains = 1 pwt.
20 pwts. = 1 ounce.
12 ounces = 1 pound.

Used for weighing gold, silver, and jewels.

APOTHECARIES' WEIGHT

20 grains = 1 scruple.
3 scruples = 1 dram.
8 drams = 1 ounce.
12 ounces = 1 pound.

The ounce and pound in this are the same as in Troy weight.

AVOIRDUPOIS WEIGHT

$27\frac{11}{32}$ grains = 1 dram.
16 drams = 1 ounce.
16 ounces = 1 pound
25 pounds = 1 quarter.
4 quarters = 1 cwt.
2,000 pounds = 1 short ton.
2,240 pounds = 1 long ton.

DRY MEASURE

2 pints = 1 quart.
8 quarts = 1 peck.
4 pecks = 1 bushel.
36 bushels = 1 chaldron.

LIQUID MEASURE

4 gills = 1 pint.
2 pints = 1 quart.
$31\frac{1}{2}$ gallons = 1 barrel.
2 barrels = 1 hogshead.

MEASURE OF SOLIDITY

1728 cubic inches = 1 cubic foot.
27 cubic feet = 1 cubic yard.

TIME MEASURE

60 seconds = 1 minute.
60 minutes = 1 hour.
24 hours = 1 day.
7 days = 1 week.
28, 29, 30 or 31 days = 1 calendar month (30 days = 1 month in computing interest.)
365 days = 1 year.
366 days = 1 leap year.

CIRCULAR MEASURE

60 seconds = 1 minute.
60 minutes = 1 degree.
30 degrees = 1 sign.
90 degrees = 1 quadrant.
4 quadrants = 12 signs, or 360 degrees = 1 circle.

LONG MEASURE

12 inches = 1 foot.
3 feet = 1 yard.
$5\frac{1}{2}$ yards = 1 rod.
40 rods = 1 furlong.
8 furlongs = 1 stat. mile.
3 miles = 1 league.

CLOTH MEASURE

$2\frac{1}{4}$ inches = 1 nail.
4 nails = 1 quarter.
4 quarters = 1 yard.

MARINERS' MEASURE

6 feet = 1 fathom.
120 fathoms = 1 cable length.
$7\frac{1}{2}$ cable lengths = 1 mile.
5,280 feet = 1 stat. mile.
6,085 feet = 1 naut. mile.

SQUARE MEASURE

144 sq. inches = 1 sq. foot.
9 sq. feet = 1 sq. yard.
$30\frac{1}{4}$ sq. yards = 1 sq. rod.
40 sq. rods = 1 rood.
4 roods = 1 acre.
640 acres = 1 sq. mile.

TABLE OF DECIMAL EQUIVALENTS

Of 8ths, 16ths, 32ds and 64ths of an inch

8ths.

$\frac{1}{8}$ = .125

$\frac{1}{4}$ = .250

$\frac{3}{8}$ = .375

$\frac{1}{2}$ = .500

$\frac{5}{8}$ = .625

$\frac{3}{4}$ = .750

$\frac{7}{8}$ = .875

16ths.

$\frac{1}{16}$ = .0625

$\frac{3}{16}$ = .1875

$\frac{5}{16}$ = .3125

$\frac{7}{16}$ = .4375

$\frac{9}{16}$ = .5625

$\frac{11}{16}$ = .6875

$\frac{13}{16}$ = .8125

$\frac{15}{16}$ = .9375

32ds.

$\frac{1}{32}$ = .03125

$\frac{3}{32}$ = .09375

$\frac{5}{32}$ = .15625

$\frac{7}{32}$ = .21875

$\frac{9}{32}$ = .28125

$\frac{11}{32}$ = .34375

$\frac{13}{32}$ = .40625

$\frac{15}{32}$ = .46875

$\frac{17}{32}$ = .53125

$\frac{19}{32}$ = .59375

$\frac{21}{32}$ = .65625

$\frac{23}{32}$ = .71875

$\frac{25}{32}$ = .78125

$\frac{27}{32}$ = .84375

$\frac{29}{32}$ = .90625

$\frac{31}{32}$ = .96875

64ths.

$\frac{1}{64}$ = .015625

$\frac{3}{64}$ = .046875

$\frac{5}{64}$ = .078125

$\frac{7}{64}$ = .109375

$\frac{9}{64}$ = .140625

$\frac{11}{64}$ = .171875

$\frac{13}{64}$ = .203125

$\frac{15}{64}$ = .234375

$\frac{17}{64}$ = .265625

$\frac{19}{64}$ = .296875

$\frac{21}{64}$ = .328125

$\frac{23}{64}$ = .359375

$\frac{25}{64}$ = .390625

$\frac{27}{64}$ = .421875

$\frac{29}{64}$ = .453125

$\frac{31}{64}$ = .484375

$\frac{33}{64}$ = .515625

$\frac{35}{64}$ = .546875

$\frac{37}{64}$ = .578125

$\frac{39}{64}$ = .609375

$\frac{41}{64}$ = .640625

$\frac{43}{64}$ = .671875

$\frac{45}{64}$ = .703125

$\frac{47}{64}$ = .734375

$\frac{49}{64}$ = .765625

$\frac{51}{64}$ = .796875

$\frac{53}{64}$ = .828125

$\frac{55}{64}$ = .859375

$\frac{57}{64}$ = .890625

$\frac{59}{64}$ = .921875

$\frac{61}{64}$ = .953125

$\frac{63}{64}$ = .984375

NOTES ON THE METRIC SYSTEM

(Kidder)

The Metric System is a system of weights and measures based upon a unit called a Meter.

The Meter was intended to be one ten-millionth part of the distance from the equator to either pole, measured on the earth's surface at the level of the sea.

The Names of derived metric denominations are formed by prefixing to the name of the primary unit of measure:

Milli, a thousandth	Hecto, one hundred
Centi, a hundredth	Kilo, a thousand
Deci, a tenth	Myria, ten thousand
Deca, ten	

This system, first adopted by France, has been extensively adopted by other countries, and is much used in the sciences and the arts. It was legalized in 1866 by Congress to be used in the United States, and is already employed by the Coast Survey, and, to some extent, by the Mint and the General Post-Office.

LINEAR MEASURES

The METER is the primary unit of lengths.

10 millimeters (mm)	= 1 centimeter (cm)	= 0.3937 inch
10 centimeters	= 1 decimeter (dm)	= 3.937 inches
10 decimeters	= 1 METER (m)	= 39.37 inches
10 meters	= 1 decameter	= 393.37 inches
10 decameters	= 1 hectometer	= 328 feet 1 inch
10 hectometers	= 1 KILOMETER (km)	= 0.62137 mile
10 kilometers	= 1 myriameter	= 6.2137 miles

The METER is used in ordinary measurements; the CENTIMETER, or MILLIMETER, in reckoning very small distances; and the KILOMETER, for roads or great distances.

A CENTIMETER is about $\frac{3}{8}$ of an inch; a METER is about 3 feet $3\frac{3}{8}$ inches; a KILOMETER is about 200 rods, or $\frac{5}{8}$ of a mile.

MEASURES OF SURFACE

The SQUARE METER is the primary unit of ordinary surfaces.

The ARE, a square, each of whose sides is ten METERS, is the unit of land measures.

100 square millimeters (mm^2) = 1 square centimeter (cm^2) =0.155 square inch.
100 square centimeters = 1 square decimeter = 15.5 square inches.
100 square decimeters = 1 square METER (m^2) = 1550 square inches, or 1.196 square yards.
100 centiares, or square meters = 1 ARE (a) = 119.6 square yards.
100 ares = 1 hectare (ha) = 2.471 acres.

CUBIC MEASURE

The CUBIC METER, or STERE, is the primary unit of a volume.

1000 cubic millimeters (mm^3) = 1 cubic centimeter (cm^3) = 0.061 cubic inch.
1000 cubic centimeters = 1 cubic decimeter (dm^3) = 61.022 cubic inches.
1000 cubic decimeters = 1 cubic METER (m^3) = 35.314 cubic feet.

The STERE is the name given to the cubic meter in measuring wood and timber. A tenth of a stere is a DECISTERE, and ten steres are a DECASTERE.

A CUBIC METER, or STERE, is about $1\frac{1}{3}$ yards, or about $2\frac{1}{5}$ cord feet.

LIQUID AND DRY MEASURES

The LITER is the primary unit of measures of capacity, and is a cube, each of whose edges is a tenth of a meter in length.

The HECTOLITER is the unit in measuring large quantities of grain, fruits, roots, and liquids.

10 millimeters (ml)	= 1 centiliter	= 0.338 fluid ounce
10 centiliters	= 1 deciliter	= 0.845 liquid gill
10 deciliters	= 1 LITER (l)	= 1.0567 liquid quarts
10 liters	= 1 Decaliter	= 2.6417 gallons
10 decaliters	= 1 HECTOLITER	= 2 bushels, 3.35 pecks
10 hectoliters	= 1 kiloliter	= 28 bushels, $1\frac{1}{2}$ pecks.

A CENTILITER is about $\frac{1}{3}$ of a fluid ounce; a LITER is about $1\frac{1}{18}$ liquid quarts, or $\frac{9}{10}$ of a dry quart; a HECTOLITER is about $2\frac{5}{6}$ bushels; and a KILOLITER is one cubic meter, or stere.

WEIGHTS

The GRAM is the primary unit of weights, and is the weight in a vacuum of a cubic centimeter of distilled water at the temperature of 39.2 F.

10 milligrams (mg)	= 1 centigram (cg)	= 0.1543 troy grain
10 centigrams	= 1 decigram (dg)	= 1.543 troy grains.
10 decigrams	= 1 GRAM (g)	= 15.432 troy grains
10 grams	= 1 decagram	= 0.3527 avoirdupois ounce
10 decagrams	= 1 hectogram	= 3.5274 avoirdupois ounces
10 hectograms	= 1 KILOGRAM (kg)	= 2.2046 avoirdupois pounds
10 kilograms	= 1 myriagram	= 22.046 avoirdupois pounds
10 myriagrams	= 1 quintal (q)	= 220.46 avoirdupois pounds
10 quintals	= 1 TONNEAU (t)	= 2204.6 avoirdupois pounds

1 kilogram per kilometer = 0.67195 pound per 1000 feet
1 pound per thousand feet = 1.4882 kilograms per kilometer
1 kilogram per square millimeter = 1.423 pounds per square inch
1 pound per square inch = 0.000743 kilogram per square millimeter

METRIC CONVERSION TABLE

The following metric conversion table has been compiled by C. W. Hunt, and is most convenient in dealing with metric weights and measures:

Millimeters × 0.03937	= inches
Millimeters ÷ 25.4	= inches
Centimeters × 0.3937	= inches
Centimeters ÷ 2.54	= inches
Meters × 39.37	= inches (Act of Congress)
Meters × 3.281	= feet
Meters × 1.094	= yards
Kilometers × 0.621	= miles
Kilometers ÷ 1.6093	= miles
Kilometers × 3280.7	= feet
Square millimeters × 0.0155	= square inches
Square millimeters ÷ 645.1	= square inches
Square centimeters × 0.155	= square inches
Square centimeters ÷ 6.451	= square inches
Square meters × 10.764	= square feet
Square kilometers × 247.1	= acres
Hectares × 2.471	= acres
Cubic centimeters ÷ 16.383	= cubic inches
Cubic centimeters ÷ 3.69	= fluid drachms (U. S. Pharmacopœia)
Cubic centimeters ÷ 29.57	= fluid ounce (U. S. Pharmacopœia)
Cubic meters × 35.315	= cubic feet
Cubic meters × 1.308	= cubic yards
Cubic meters × 264.2	= gallons (231 cubic inches)
Liters × 61.022	= cubic inches (Act of Congress)
Liters × 33.84	= fluid ounces (U. S. Pharmacopœia)
Liters × 0.2642	= gallons (231 cubic inches)
Liters ÷ 3.78	= gallons (231 cubic inches)
Liters ÷ 28.316	= cubic feet
Hectoliters × 3.531	= cubic feet
Hectoliters × 2.84	= bushels (2,150.42 cubic inches)
Hectoliters × 0.131	= cubic yards
Hectoliters × 26.42	= gallons (231 cubic inches)
Grams × 15.432	= grains (Act of Congress)
Grams × 981	= dynes
Grams (water) ÷ 29.57	= fluid ounces
Grams ÷ 28.35	= ounces avoirdupois
Grams per cubic centimeter ÷ 27.7	= pounds per cubic inch
Joule × 0.7373	= foot-pounds
Kilograms × 2.2046	= pounds
Kilograms × 35.3	= ounces avoirdupois
Kilograms ÷ 1102.3	= tons (2000 pounds)
Kilograms per sq cm × 14.223	= pounds per square inch
Kilogrammeters × 7.233	= foot-pounds
Kilograms per meter × 0.672	= pounds per square foot
Kilograms per cubic meter × 0.062	= pounds per cubic foot
Kilograms per cheval — vapeur × 2.235	= pounds per horse-power
Kilowatts × 1.34	= horse-power
Watts ÷ 746	= horse-power
Watts × 0.7373	= foot-pounds per second
Calorie × 3.968	= British thermal units (B. T. U.)
Cheval-vapeur × 0.9863	= horse-power
(Centigrade × 1.8) + 32	= degrees Fahrenheit
Francs × 0.193	= dollars
Gravity, Paris	= 980.94 centimeter per second

The GRAM is used in weighing gold, jewels, letters and small quantities of things. The KILOGRAM, or for brevity KILO, is used by grocers;

and the Tonneau, or Metric Ton, is used in finding the weight of very heavy articles.

A Gram is about $15\frac{1}{2}$ grains troy; the Kilo about $2\frac{1}{5}$ pounds avoirdupois; and the Metric Ton, about 2,205 pounds.

A Kilo is the weight of a liter of water at its greatest density; and the Metric Ton, of a cubic meter of water.

Metric numbers are written with the decimal point (.) at the right of the figures denoting the unit; thus the expression, 15 meters 3 centimeters, is written, 15.03 m.

When metric numbers are expressed by figures, the part of the expression at the left of the decimal point is read as the number of the unit, and the part at the right, if any, as a number of the lowest denomination indicated, or as a decimal part of the unit; thus, 46.525m is read 46 meters and 525 millimeters, or 46 and 525 thousandths meters.

In writing and reading metric numbers, according as the scale is 10,000 or 1,000, each denomination should be allowed one, two, or three orders of figures.

FEET CONVERTED INTO METERS

(Molesworth Metrical Tables)

Feet	0	1	2	3	4
0	–	0.304794	0.609589	0.914383	1.21918
10	3.047945	3.35274	3.65753	3.96233	4.26712
20	6.095890	6.40068	6.70548	7.01027	7.31507
30	9.143835	9.44863	9.75342	10.0582	10.3630
40	12.19178	12.4966	12.8014	13.1062	13.4110
50	15.23972	15.5445	15.8493	16.1541	16.4589
60	18.28767	18.5925	18.8973	19.2020	19.5068
70	21.33561	21.6404	21.9452	22.2500	22.5548
80	24.38356	24.6884	24.9931	25.2979	25.6027
90	27.43150	27.7363	28.0411	28.3459	28.6507

Feet	5	6	7	8	9
0	1.52397	1.82877	2.13356	2.43836	2.74315
10	4.57192	4.87671	5.18151	5.48630	5.79110
20	7.61986	7.92466	8.22945	8.53425	8.83904
30	10.6678	10.9726	11.2774	11.5822	11.8870
40	13.7158	14.0205	14.3253	14.6301	14.9349
50	16.7637	17.0685	17.3733	17.6781	17.9829
60	19.8116	20.1164	20.4212	20.7260	21.0308
70	22.8596	23.1644	23.4692	23.7740	24.0788
80	25.9075	26.2123	26.5171	26.8219	27.1267
90	28.9555	29.2603	29.5651	29.8699	30.1747

Example: 44 ft. = 13.411 meters = 134.11 decimeters = 1,341.1 centimeters = 13,411 millimeters. The above mentioned work contains eighty pages of conversion tables similar to the above.

INCHES AND SIXTEENTHS CONVERTED INTO MILLIMETERS

Inches	0	1	2	3	4	5
–	–	25.400	50.799	76.199	101.60	127.00
1/16	1.5875	26.987	52.387	77.786	103.19	128.59
1/8	3.1749	28.574	53.974	79.374	104.77	130.17
3/16	4.7624	30.162	55.561	80.961	106.36	131.76
1/4	6.3499	31.749	57.149	82.549	107.95	133.35
5/16	7.9374	33.337	58.736	84.136	109.54	134.94
3/8	9.5248	34.924	60.324	85.723	111.12	136.52
7/16	11.112	36.512	61.911	87.311	112.71	138.11
1/2	12.700	38.099	63.499	88.898	114.30	139.70
9/16	14.287	39.687	65.086	90.486	115.89	141.28
5/8	15.875	41.274	66.674	92.073	117.47	142.87
11/16	17.462	42.862	68.261	93.661	119.06	144.46
3/4	19.050	44.449	69.849	95.248	120.65	146.05
13/16	20.637	46.037	71.436	96.836	122.24	147.63
7/8	22.225	47.624	73.024	98.423	123.82	149.22
15/16	23.812	49.212	74.611	100.01	125.41	150.81

Inches	6	7	8	9	10	11
–	152.40	177.80	203.20	228.60	254.00	279.39
1/16	153.98	179.38	204.78	230.18	255.58	280.98
1/8	155.57	180.97	206.37	231.77	257.17	282.57
3/16	157.16	182.56	207.96	233.36	258.76	284.16
1/4	158.75	184.15	209.55	234.95	260.35	285.74
5/16	160.33	185.73	211.13	236.53	261.93	287.33
3/8	161.92	187.32	212.72	238.12	263.52	288.92
7/16	163.51	188.91	214.31	239.71	265.11	290.51
1/2	165.10	190.50	215.90	241.30	266.70	292.09
9/16	166.68	192.08	217.48	242.88	268.28	293.68
5/8	168.27	193.67	219.07	244.47	269.87	295.27
11/16	169.86	195.26	220.66	246.06	271.46	296.86
3/4	171.45	196.85	222.25	247.65	273.05	298.44
13/16	173.03	198.43	223.83	249.23	274.63	300.03
7/8	174.62	200.02	225.42	250.82	276.22	301.62
15/16	176.21	201.61	227.01	252.41	277.81	303.21

For meters, move the decimal point THREE figures forward.

EXAMPLE: $8\frac{3}{16}$ inches = 207.96 millimeters = 20.796 centimeters = 2.0796 decimeters = 0.20796 meter.

MEASURING TEMPERATURES

THERMAL or HEATING VALUE is that property which a body has for absorbing or giving off heat.

THE FAHRENHEIT THERMOMETER ("F" or "Fahr.") is used in America, Great Britain and the British Colonies. The freezing point of water is taken at 32 degrees above zero, and the temperature of pure boiling water at 212 degrees. In both cases the measurement is recorded under the ordinary atmospheric pressure of 14.7 pounds per square inch. Between 32 and 212 degrees there are 180 degrees, which are usually spaced into 1-degree intervals.

THE CENTIGRADE THERMOMETER ("C"), known in Germany as "Celsius thermometer," is used in France and most other countries in Europe. 0 degrees or zero corresponds to the freezing point, or melting ice (which is marked 32 on the Fahrenheit scale), and 100 degrees to boiling water. From the freezing to the boiling point there are 100 degrees.

THE REAUMUR THERMOMETER ("R") is used in Russia, Sweden, Turkey, and Egypt. 0 degrees or zero corresponds to melting ice, 80 degrees to boiling water. From freezing to boiling points there are 80 degrees.

It will be noted that each degree Fahrenheit is $\frac{5}{9}$ of a degree Centigrade, and $\frac{4}{9}$ of a degree Reaumur. The Centigrade temperature interval between the freezing and the boiling point being 100 and the Fahrenheit interval 180, it follows that 1 degree Centigrade is equal to 1.8 Fahrenheit.

Centigrade temperatures are converted into Fahrenheit's scale by multiplying the former by 9 and dividing by 5, and adding 32 degrees to the quotient; and conversely, Fahrenheit temperatures are converted into Centigrade scale by deducting 32 and taking $\frac{5}{9}$ of the remainder.

EXAMPLE: Centigrade degrees $\frac{20 \times 9}{5} = 36$,

and $36 + 32 = 68$ degrees F.

Fahrenheit degrees $68 - 32 = 36$,

and $\frac{36 \times 5}{9} = 20$ degrees C.

CONVERSION OF THERMOMETER READINGS

DEGREES CENTIGRADE TO DEGREES FAHRENHEIT

C	F	C	F	C	F	C	F	C	F	C	F
—40	—40.0	+5	+41.0	+40	+104.0	+175	+347	+350	+662	+750	+1382
—38	—36.4	6	42.8	41	105.8	180	356	355	671	800	1472
—36	—32.8	7	44.6	42	107.6	185	365	360	680	850	1562
—34	—29.2	8	46.4	43	109.4	190	374	365	689	900	1652
—32	—25.6	9	48.2	44	111.2	195	383	370	698	950	1742
—30	—22.0	10	50.0	45	113.0	200	392	375	707	1000	1832
—28	—18.4	11	51.8	46	114.8	205	401	380	716	1050	1922
—26	—14.8	12	53.6	47	116.6	210	410	385	725	1100	2012
—24	—11.2	13	55.4	48	118.4	215	419	390	734	1150	2102
—22	—7.6	14	57.2	49	120.2	220	428	395	743	1200	2192
—20	—4.0	15	59.0	50	122.0	225	437	400	752	1250	2282
—19	—2.2	16	60.8	55	131.0	230	446	405	761	1300	2372
—18	—0.4	17	62.6	60	140.0	235	455	410	770	1350	2462
—17	+1.4	18	64.4	65	149.0	240	464	415	779	1400	2552
—16	3.2	19	66.2	70	158.0	245	473	420	788	1450	2642
—15	5.0	20	68.0	75	167.0	250	482	425	797	1500	2732
—14	6.8	21	69.8	80	176.0	255	491	430	806	1550	2822
—13	8.6	22	71.6	85	185.0	260	500	435	815	1600	2912
—12	10.4	23	73.4	90	194.0	265	509	440	824	1650	3002
—11	12.2	24	75.2	95	203.0	270	518	445	833	1700	3092
—10	14.0	25	77.0	100	212.0	275	527	450	842	1750	3182
—9	15.8	26	78.8	105	221.0	280	536	455	851	1800	3272
—8	17.6	27	80.6	110	230.0	285	545	460	860	1850	3362
—7	19.4	28	82.4	115	239.0	290	554	465	869	1900	3452
—6	21.2	29	84.2	120	248.0	295	563	470	878	1950	3542
—5	23.0	30	86.0	125	257.0	300	572	475	887	2000	3632
—4	24.8	31	87.8	130	266.0	305	581	480	896	2050	3722
—3	26.6	32	89.6	135	275.0	310	590	485	905	2100	3812
—2	28.4	33	91.4	140	284.0	315	599	490	914	2150	3902
—1	30.2	34	93.2	145	293.0	320	608	495	923	2200	3992
0	32.0	35	95.0	150	302.0	325	617	500	932	2250	4082
+1	33.8	36	96.8	155	311.0	330	626	550	1022	2300	4172
2	35.6	37	98.6	160	320.0	335	635	600	1112	2350	4262
3	37.4	38	100.4	165	329.0	340	644	650	1202	2400	4352
4	39.2	39	102.2	170	338.0	345	653	700	1292	2450	4442

Table of values for Interpolation in the above table:

Degrees Centigrade	1	2	3	4	5	6	7	8	9
Degrees Fahrenheit	1.8	3.6	5.4	7.2	9.0	10.8	12.6	14.4	16.2

CONVERSION OF THERMOMETER READINGS

DEGREES FAHRENHEIT TO DEGREES CENTIGRADE.*

F	C	F	C	F	C	F	C	F	C	F	C
−40	−40.00	+30	−1.11	+80	+26.67	+250	+121.11	+500	+260.00	+900	+482.22
−38	−38.89	31	−0.56	81	27.22	255	123.89	505	262.78	910	487.78
−36	−37.78	32	0.00	82	27.78	260	126.67	510	265.56	920	493.33
−34	−36.67	33	+0.56	83	28.33	265	129.44	515	268.33	930	498.89
−32	−35.56	34	1.11	84	28.89	270	132.22	520	271.11	940	504.44
−30	−34.44	35	1.67	85	29.44	275	135.00	525	273.89	950	510.00
−28	−33.33	36	2.22	86	30.00	280	137.78	530	276.67	960	515.56
−26	−32.22	37	2.78	87	30.56	285	140.55	535	279.44	970	521.11
−24	−31.11	38	3.33	88	31.11	290	143.33	540	282.22	980	526.67
−22	−30.00	39	3.89	89	31.67	295	146.11	545	285.00	990	532.22
−20	−28.89	40	4.44	90	32.22	300	148.89	550	287.78	1000	537.78
−18	−27.78	41	5.00	91	32.78	305	151.67	555	290.55	1050	565.56
−16	−26.67	42	5.56	92	33.33	310	154.44	560	293.33	1100	593.33
−14	−25.56	43	6.11	93	33.89	315	157.22	565	296.11	1150	621.11
−12	−24.44	44	6.67	94	39.44	320	160.00	570	298.89	1200	648.89
−10	−23.33	45	7.22	95	35.00	325	162.78	575	301.67	1250	676.67
− 8	−22.22	46	7.78	96	35.56	330	165.56	580	304.44	1300	704.44
− 6	−21.11	47	8.33	97	36.11	335	168.33	585	307.22	1350	732 22
− 4	−20.00	48	8.89	98	36.67	340	171.11	590	310.00	1400	760.00
− 2	−18.89	49	9.44	99	37.22	345	173.89	595	312.78	1450	787.78
0	−17.78	50	10.00	100	37.78	350	176.67	600	315.56	1500	815.56
+ 1	−17.22	51	10.56	105	40.55	355	179.44	610	321.11	1550	843.33
2	−16.67	52	11.11	110	43.33	360	182.22	620	326.67	1600	871.11
3	−16.11	53	11.67	115	46.11	365	185.00	630	332.22	1650	898.89
4	−15.56	54	12.22	120	48.89	370	187.78	640	337.78	1700	926.67
5	−15.00	55	12.78	125	51.67	375	190.55	650	343.33	1750	954.44
6	−14.44	56	13.33	130	54.44	380	193.33	660	348.89	1800	982.22
7	−13.89	57	13.89	135	57.22	385	196.11	670	354.44	1850	1010.00
8	−13.33	58	14.44	140	60.00	390	198.89	680	360.00	1900	1037.78
9	−12.78	59	15.00	145	62.78	395	201.67	690	365.56	1950	1065.56
10	−12.22	60	15.56	150	65.56	400	204.44	700	371.11	2000	1093.33
11	−11.67	61	16.11	155	68.33	405	207.22	710	376.67	2050	1121.11
12	−11.11	62	16.67	160	71.11	410	210.00	720	382.22	2100	1148.89
13	−10.56	63	17.22	165	73.89	415	212.78	730	387.78	2150	1176.67
14	−10.00	64	17.78	170	76.67	420	215.56	740	393.33	2200	1204.44
15	− 9.44	65	18.33	175	79.44	425	218.33	750	398.89	2250	1232.22
16	− 8.89	66	18.89	180	82.22	430	221.11	760	404.44	2300	1260.00
17	− 8.33	67	19.44	185	85.00	435	223.89	770	410.00	2350	1287.78
18	− 7.78	68	20.00	190	87.78	440	226.67	780	415.56	2400	1315.56
19	− 7.22	69	20.56	195	90.55	445	229.44	790	421.11	2450	1343.33
20	− 6.67	70	21.11	200	93.33	450	232.22	800	426.67	2500	1371.11
21	− 6.11	71	21.67	205	96.11	455	235.00	810	432.22	2550	1398.89
22	− 5.56	72	22.22	210	98.89	460	237.78	820	437.78	2600	1426.67
23	− 5.00	73	22.78	215	101.67	465	240.55	830	443.33	2650	1454.44
24	− 4.44	74	23.33	220	104.44	470	243.33	840	448.89	2700	1482.22
25	− 3.89	75	23.89	225	107.22	475	246.11	850	454.44	2750	1510.00
26	− 3.33	76	24.44	230	110.00	480	248.89	860	460.00	2800	1537.78
27	− 2.78	77	25.00	235	112.78	485	251.67	870	465.56	2850	1565.56
28	− 2.22	78	25.56	240	115.56	490	254.44	880	471.11	2900	1593.33
29	− 1.67	79	26.11	245	118.33	495	257.22	890	476.67	2950	1621.11

Table of values for Interpolation in the above table:

Degrees Fahrenheit	1	2	3	4	5	6	7	8	9
Degrees Centigrade	0.56	1.11	1.67	2.22	2.78	3.33	3.89	4.44	5.00

*All decimals in the table are repeating decimals: 37.78 is really 37.777.

CAPACITY OF CYLINDRICAL TANKS AND CISTERNS

(In United States Gallons of 231 cubic inches)

Capacity of Cylindrical Tanks and Cisterns

Inside Diam.	Water Depth 1 ft.	Water Depth 4 ft.	Water Depth 5 ft.	Water Depth 6 ft.	Water Depth 7 ft.	Water Depth 8 ft.	Water Depth 9 ft.	Water Depth 12 ft.	Water Depth 15 ft.
4 ft.	94.0	376	470	564	658	752	846	1,128	1,410
4 ft. 6 in.	119.0	476	595	714	833	952	1,071	1,428	1,785
5 ft.	146.9	588	734	881	1,028	1,175	1,322	1,763	2,203
5 ft. 6 in.	177.7	711	889	1,066	1,244	1,422	1,600	2,133	2,666
6 ft.	211.5	846	1,058	1,269	1,481	1,692	1,904	2,538	3,173
6 ft. 3 in.	229.5	918	1,148	1,377	1,607	1,836	2,066	2,754	3,443
6 ft. 6 in.	248.2	993	1,241	1,489	1,738	1,986	2,234	2,979	3,724
6 ft. 9 in.	267.7	1,071	1,338	1,606	1,874	2,142	2,409	3,212	4,015
7 ft.	287.9	1,152	1,439	1,727	2,015	2,303	2,591	3,455	4,318
7 ft. 3 in.	308.8	1,235	1,544	1,853	2,162	2,471	2,779	3,706	4,632
7 ft. 6 in.	330.5	1,322	1,652	1,983	2,313	2,544	2,974	3,966	4,957
7 ft. 9 in.	352.9	1,412	1,764	2,117	2,470	2,823	3,176	4,235	5,293
8 ft.	376.0	1,504	1,880	2,256	2,632	3,008	3,384	4,512	5,640
8 ft. 3 in.	399.9	1,600	1,999	2,399	2,799	3,199	3,599	4,799	5,998
8 ft. 6 in.	424.5	1,698	2,122	2,547	2,971	3,396	3,820	5,094	6,367
8 ft. 9 in.	449.8	1,799	2,249	2,699	3,149	3,599	4,148	5,398	6,747
9 ft.	475.9	1,904	2,380	2,855	3,331	3,807	4,283	5,711	7,138
9 ft. 3 in.	502.7	2,011	2,514	3,016	3,519	4,022	4,524	6,032	7,540
9 ft. 6 in.	530.2	2,121	2,651	3,181	3,712	4,242	4,772	6,363	7,954
9 ft. 9 in.	558.5	2,234	2,793	3,351	3,910	4,468	5,027	6,702	8,378
10 ft.	587.5	2,350	2,938	3,525	4,113	4,700	5,288	7,050	8,813
10 ft. 3 in.	617.3	2,469	3,086	3,704	4,321	4,938	5,555	7,407	9,259
10 ft. 6 in.	647.7	2,591	3,239	3,886	4,534	5,182	5,830	7,773	9,716
10 ft. 9 in.	679.0	2,716	3,395	4,074	4,753	5,432	6,111	8,147	10,184
11 ft.	710.9	2,844	3,555	4,265	4,976	5,687	6,398	8,531	10,664
11 ft. 3 in.	743.6	2,974	3,718	4,462	5,205	5,949	6,692	8,923	11,154
11 ft. 6 in.	777.0	3,108	3,885	4,662	5,439	6,216	6,993	9,324	11,655
11 ft. 9 in.	811.1	3,245	4,056	4,867	5,678	6,489	7,300	9,734	12,167
12 ft.	846.0	3,384	4,230	5,076	5,922	6,768	7,614	10,152	12,691
12 ft. 6 in.	918.0	3,672	4,590	5,508	6,426	7,344	8,262	11,016	13,770
13 ft.	992.9	3,972	4,965	5,957	6,950	7,943	8,936	11,915	14,894
13 ft. 6 in.	1,070.8	4,283	5,354	6,425	7,495	8,566	9,637	12,849	16,061
14 ft.	1,151.5	4,606	5,758	6,909	8,061	9,212	10,364	13,819	17,273
14 ft. 6 in.	1,235.3	4,941	6,176	7,412	8,647	9,882	11,117	14,823	18,529
15 ft.	1,321.9	5,288	6,610	7,932	9,253	10,575	11,807	15,863	19,829
15 ft. 6 in.	1,411.5	5,646	7,058	8,469	9,881	11,292	12,704	16,938	21,173
16 ft.	1,504.1	6,016	7,520	9,024	10,528	12,032	13,537	18,049	22,561

CAPACITY OF CYLINDRICAL TANKS AND CISTERNS (cont.)

(In United States Gallons of 231 cubic inches)

CAPACITY OF CYLINDRICAL TANKS AND CISTERNS

INSIDE DIAM.	Water Depth 1 ft.	Water Depth 4 ft.	Water Depth 5 ft.	Water Depth 6 ft.	Water Depth 7 ft.	Water Depth 8 ft.	Water Depth 9 ft.	Water Depth 12 ft.	Water Depth 15 ft
17 ft. .	1,697.9	6,792	8,490	10,188	11,886	13,583	15,281	20,375	25,469
18 ft. .	1,903.6	7,614	9,518	11,421	13,325	15,228	17,132	22,843	28,553
19 ft. .	2,120.9	8,484	10,605	12,726	14,847	16,968	19,089	25,451	31,814
20 ft. .	2,350.1	9,400	11,750	14,100	16,451	18,801	21,151	28,201	35,251
21 ft. .	2,590.8	10,363	12,954	15,545	18,136	20,726	23,317	31,090	38,862
22 ft. .	2,843.6	11,374	14,218	17,062	19,905	22,749	25,592	34,123	42,654
23 ft. .	3,107.9	12,432	15,540	18,647	21,755	24,863	27.971	37,295	46,619
24 ft. .	3,384.1	13,536	16,921	20,305	23,689	27,073	30,457	40,609	50,762
25 ft. .	3,671.7	14,687	18,359	22,030	25,702	29,374	33.045	44,060	55,076
26 ft. .	3,971.6	15,887	19,858	23,830	27,801	31,773	35.745	47,660	59,575
27 ft. .	4,282.7	17,131	21,414	25,696	29,979	34,262	38,544	51,392	64,241
28 ft. .	4,606.2	18,425	23,031	27,637	32,243	36,849	41,455	55,274	69,092
29 ft. .	4,940.7	19,763	24,704	29,644	34,585	39,526	44,466	59,288	74,111
30 ft. .	5,287.7	21,151	26,438	31,726	37,014	42,301	47,589	63,452	79,315
31 ft. .	5,645.7	22,583	28,229	33,874	39,520	45,166	50,811	67,748	84,686
32 ft. .	6,016.2	24,065	30,081	36,097	42,113	48,130	54,146	72,194	90,243
33 ft. .	6,397.6	25,590	31,988	38,386	44,783	51,181	57,578	76,771	95,964
34 ft. .	6,791.2	27,165	33,956	40,747	47,538	54,330	61,121	81,494	101,868
35 ft. .	7,197.1	28,788	35,986	43,183	50,380	57,577	64,774	86,365	107,957
36 ft. .	7,614.4	30,458	38,072	45,686	53,301	60,915	68,530	91,372	114,216
37 ft. .	8,043.1	32,172	40,216	48,259	56,302	64,345	72,388	96,517	120,647
38 ft. .	8,483.7	33,935	42,419	50,902	59,386	67,870	76,353	101,804	127,256
39 ft. .	8,936.2	35,745	44,681	53,617	62,553	71.490	80,426	107,234	134,043
40 ft.	9,400.3	37,601	47,002	56,402	65,802	75,202	84,603	112,804	141,005
42 ft.	10,362.7	41,451	51,814	62,176	72,539	82,902	93,264	124,357	155,441
45 ft. .	11,897.3	47,589	59,486	71,384	83,281	95,178	107,075	142,767	178,459
47 ft. .	12,977.1	51,908	64,886	77,863	90,840	103,817	116,794	155,725	194,657
50 ft. .	14,688.0	58,752	73,440	88,128	102,816	117,504	132,192	176,256	220,319
60 ft. .	21,150.7	84,603	105,753	126,904	148,055	169,205	190,356	253,808	317,260
70 ft. .	28,788.4	115,154	143,942	172,730	201,519	230,307	259,096	345,461	431,826
80 ft. .	37,600.8	150,403	188,004	225,605	263,206	300,806	338,407	451,210	564,012
90 ft. .	47,588.8	190,355	237,944	285,533	333,122	380,710	428,299	571,066	713,832
100 ft. .	58,752.0	235,008	293,760	352,512	411,264	470,016	528,768	705,024	881,280

1 cubic foot contains 7½ gallons nearly, or 7.48052 gallons exactly.
1 cubic foot of pure water, at a temperature of 60 degrees Fahrenheit, weighs 62.366 lbs.
1 U. S. gallon of pure water, at a temperature of 60 degrees Fahrenheit, weighs 8.331 lbs.
240.07 gallons of water weigh one ton or 2000 lbs.
1000 gallons of water weigh 4.165 tons, or 4⅛ tons approximately.

The amount of water required to fill an ordinary automatic sprinkler system is about one gallon per sprinkler. This includes riser and all distribution pipes within the mill, but does not include ground mains from pump or city supply to base of riser. This figure (1 gallon per head) applies specially to systems piped from centre with 75 to 115 heads on each floor. If system of 115 heads is fed from end instead of centre, contents will be about 1¼ gallons per head. For large systems, with 6-inch riser and about 250 heads per floor, contents, if riser is in centre, will be about 1¼ gallons per head, and if riser is at one end, will be 1½ gallons per head.

ELECTRICAL DEFINITIONS

Ohm.—The practical unit of electrical resistance. It is the resistance of a column of mercury one square millimeter in section, 106 centimeters long, at a temperature of 32° Fahr. This is about equivalent to the resistance of 1000 ft. of No. 10 (B & S gauge) pure copper wire of a temperature of 75°.

Ampere.—The practical unit of electrical current. It is the current produced by an electro-motive force of one volt in a circuit having a resistance of one ohm. It is the unit of volume or strength of the electric current.

Volt.—The practical unit of electro-motive force or a unit of pressure.

Voltage.—The electro-motive force of a circuit reckoned in volts. It is this electro-motive force (E. M. F.) which causes a current to flow in a closed circuit.

Watt.—The practical unit of electrical power or rate of working. It is the power due to the current of one ampere flowing under an electro-motive force of one volt equal, approximately, to 1/746 of one H. P.

Kilowatt.—A unit of electrical power equal to 1000 watts. Electrical power is usually expressed in kilowatts. A kilowatt equals 1.34 H. P.

Alternating Current.—A succession of electrical currents which rise and fall in strength and flow alternately in opposite directions at regular intervals. The currents or impulses vary in intensity.

Direct Current.—An electrical current constant in direction, though not necessarily so in value.

Continuous Current.—A direct current constant in both value and direction, as a result of constant pressure.

Candle Power.—The standard candle by which all lights are measured is legally held to be a sperm candle consuming 120 grains of wax per hour. In practical measurements standardized incandescent lamps are more reliable and accurate than the primary standard. According to experiments made by the Government of the United States a one candle power white light is visible at a distance of a little more than a mile; one of three candle power is visible at two miles.

In 1909 a photometric unit for an international candle power was established by agreement among Great Britain, France, and America, and approved by other countries. This new unit is 1.6 per cent. less than the candle hitherto the standard in the United States.

Load Factor.—The load factor of a machine, plant, or system, is the ratio of the average power to the maximum power during a certain period of time. The average power is taken over a certain interval of time, such as a day or a year, and the maximum is taken over a short interval of the maximum load within that interval.

HEATING

To Find Amount of Radiation Required:

Mill's rule, sometimes called the rule "2–20–200," is as follows: "To find the amount of radiation required to heat a room with low-pressure steam to 70 degrees Fahr., when the outside temperature is at zero, allow 1 sq. ft. of radiation for every 200 cu. ft. of contents, 1 sq. ft. of radiation for every 20 sq. ft. of outside wall surface, and 1 sq. ft. of radiation for every 2 sq. ft. of glass surface (counting outside doors as glass surface). The sum of these results will be the amount of radiation required."

For hot water, add 60 per cent. to the results obtained by rule for low-pressure steam; for semi-direct (direct-indirect) radiation, add 25 per cent.; for indirect steam, add 50 per cent.; for indirect hot water, add 75 per cent. to the amount of direct radiation obtained by rule.

These rules do not take into consideration the factors of extraordinary exposure, and such additions should be made to the figures obtained as will compensate for such extraordinary heat losses.

It is considered to be excellent practice to add 10 per cent. to the radiation figures for rooms having a northern, northwestern, or western exposure, and when a building is heated intermittently to increase the radiation about 25 per cent., and, provided the building is loosely constructed or without proper weather protection, the amount of radiation figured must be strengthened accordingly.

As an example of estimating, we will consider a room 12 ft. x 16 ft. in area, having a ceiling 10 ft. high; the room contains two single windows 3 ft. x 6 ft. and one large window 5 ft. x 6 ft.:

$$3 \times 6 = 18 \times 2 = 36$$
$$5 \times 6 = 30 \quad = 30$$

66 sq. ft. windows.

$$12 + 16 \times 10 = 280 \text{ sq. ft. exposed wall.}$$
$$12 \times 16 \times 10 = 1920 \text{ cu. ft. contents.}$$
$$66 \div 2 = 33$$
$$280 \div 20 = 14$$
$$1920 \div 200 = 9.6$$

56.6 sq. ft. direct radiation required.

The room requires 33 sq. ft. of direct radiation low-pressure steam, to compensate for heat losses through cooling by the window glass; 14 sq. ft. for loss through cooling by exposed wall surface, and 9.6 sq. ft. to make up for the loss due to leakage, which is one complete change of air in the room hourly. If hot water is used, add 60 per cent. = 90.5 sq. ft.

Note.—In practice I have found invariably the amount of heating surface required was somewhat less than would be called for in following the above rule. I consider that the rule is too generous except in greatly exposed situations.—C. H. Fish.

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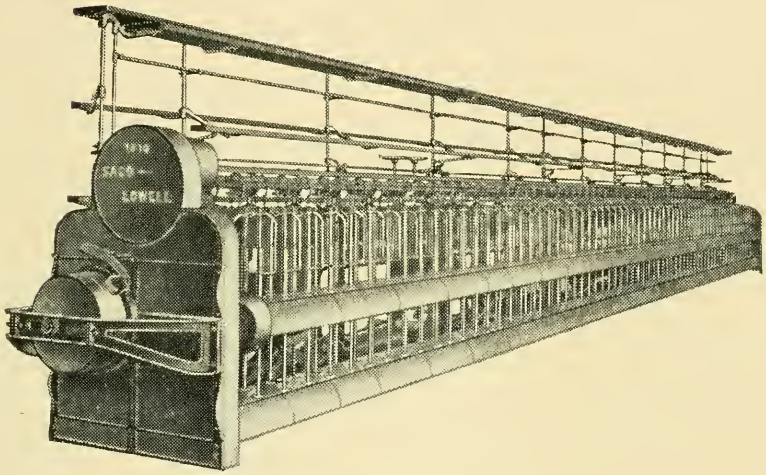

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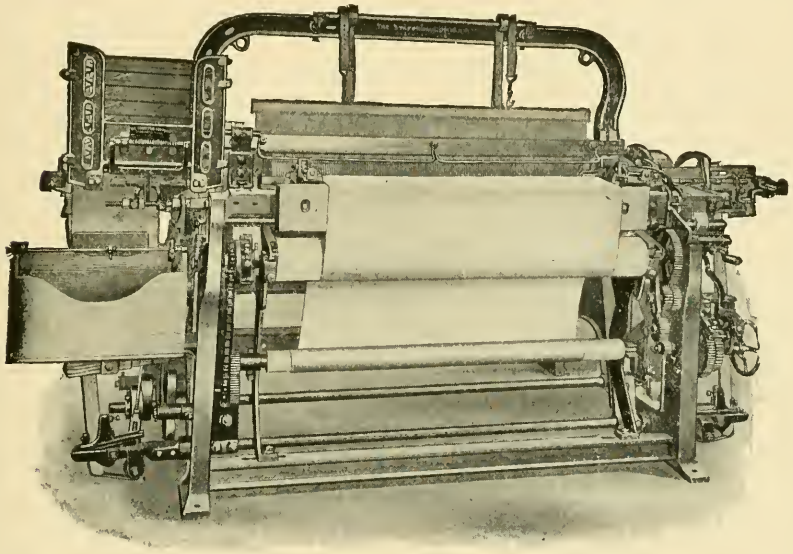

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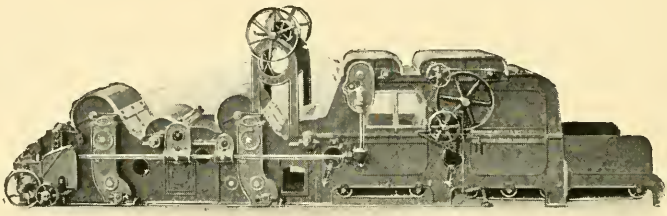

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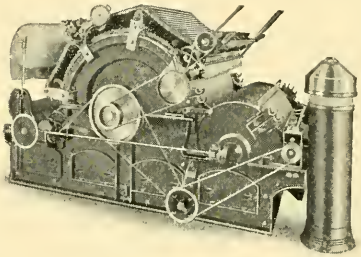

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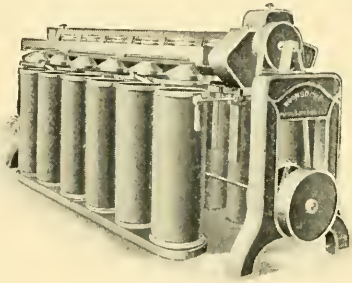

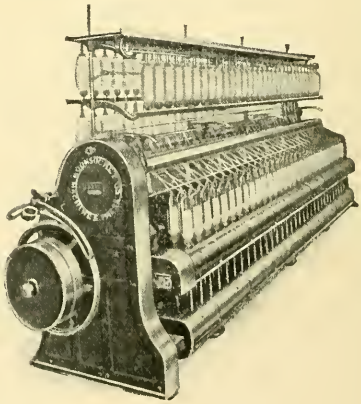

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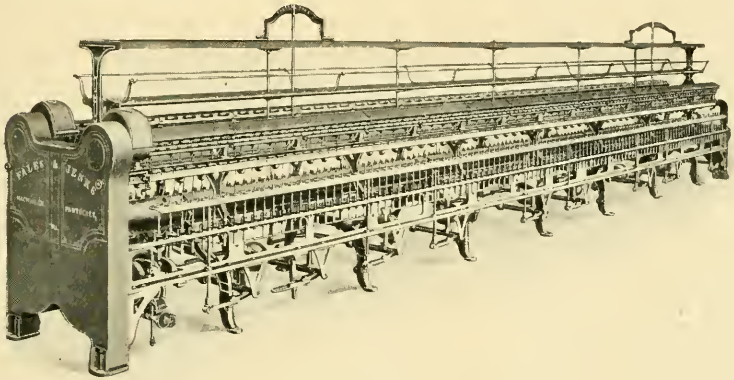

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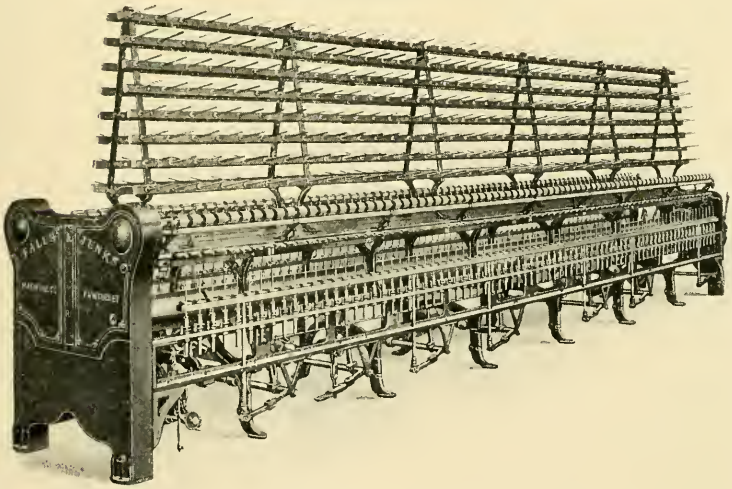

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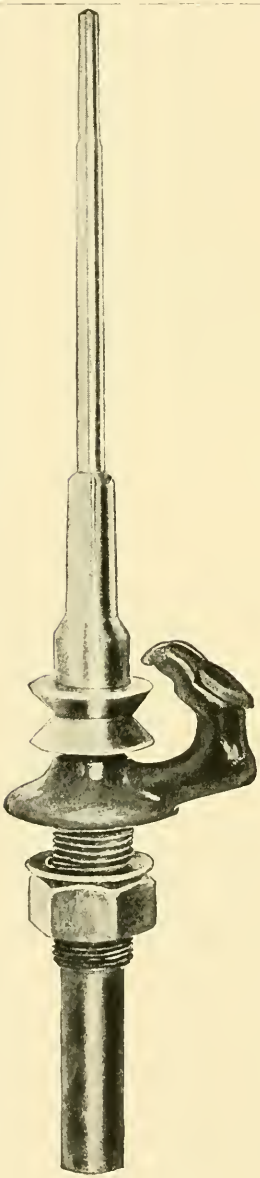

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Goodbrand & Co.

Cloth and Yarn Testing Apparatus

Selling Agent for

Joseph Sykes Bros.

Hardened and Tempered Steel Card Clothing for Cotton

Dronsfield Bros., Limited

Emery Wheel Grinders, Emery Fillet and Flat Grinding Machines

Manufacturer of

"Firth Vacuum Specialties"

For Textile Mills

D. C. S. & C. S.
Dustless Card Stripping and Cleaning System

From Central Station

Broomless Floor Sweeper

Portable

Dustless Card Stripping Apparatus

Portable

General Machinery Cleaning

From Central Station

Indispensable on Combing, Ribbon Lap, Knitting and Cordage Braiding Machines

Prompt Attention Given to Inquiries

LEIGH & BUTLER

232 Summer Street, Boston, Mass., U.S.A.

IMPORTING ENGINEERS

TEXTILE MACHINERY

Sole Agents in the United States and Canada for

PLATT BROS. & CO., Ltd.

Complete Equipment of
Cotton, Worsted and Woolen Mills, also Cotton Waste Mills

MATHER & PLATT, Ltd.

Equipment of complete works for
Bleaching, Calico Printing, Dyeing and Finishing
Patent Mechanical Filters for Town Supplies
and all Industrial Purposes

WILSON BROS. BOBBIN CO.

Bobbins, Spools, Shuttles, Etc.

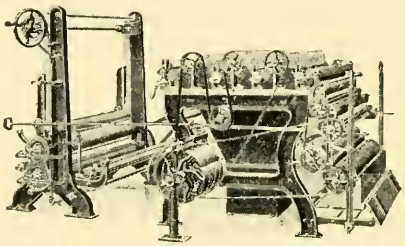
Also Agents for Sykes' Card Clothing for Cotton
Critchley's Card Clothing for Woolen and Worsted
Dronsfield's Grinding Machinery and Emery Fillet
Cockill's Special Endless Double Cone Belts and Stretchless Belting

Wool Washing and Drying Machines. Napping Machines
Harding's Pins, Fallers and Circles
Cotton Driving Rope, Scroll Banding, etc.
Condenser, Gill Box and French Rubbing Leathers, etc.

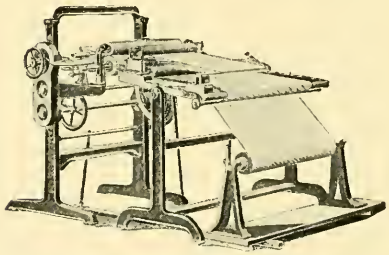
CURTIS & MARBLE MACHINE CO.

WORCESTER, MASS.

CLOTH ROOM AND PACKAGING MACHINERY FOR COTTON GOODS



COTTON BRUSHING MACHINE
With Calender Rolling Machine



SCHOLFIELD HORIZONTAL DOUBLING
AND WINDING MACHINE

Inspecting
Sewing
Singeing
Shearing
Brushing
Calender Rolling
Measuring
Spreading
Rolling
Trade Marking
Winding
Folding
Doubling
Packaging, Etc., Etc.

Finishing Machinery for Woolen, Worsted and Felt Goods, Carpets, Plushes, Silks, Embroideries, Rubberized Fabrics, Etc.

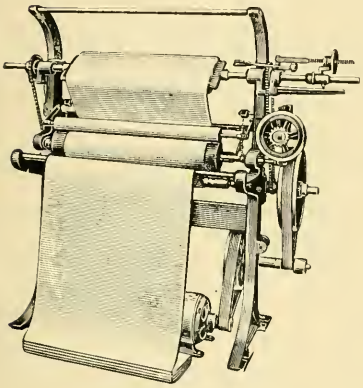
Picking, Burring and Mixing Machines for Wool or Mixed Stock.

PARKS & WOOLSON MACHINE CO

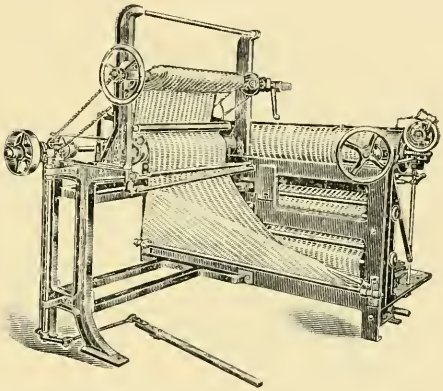
SPRINGFIELD VERMONT U S A

COTTON PACKAGING MACHINERY

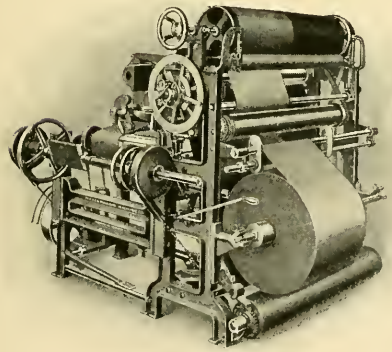
WINDING, ROLLING, DOUBLING, MEASURING, TRADEMARKING, YARDNUMBERING, INSPECTING



Lancashire Winder



Springfield Doubling Winder



Model E New York Fabric Packaging Machine or Chinaman

The Model E is specially for Cottons

Measures, trademarks, yard-numbers, doubles and winds in one operation

It automatically packages into predetermined yardages from large batch roll

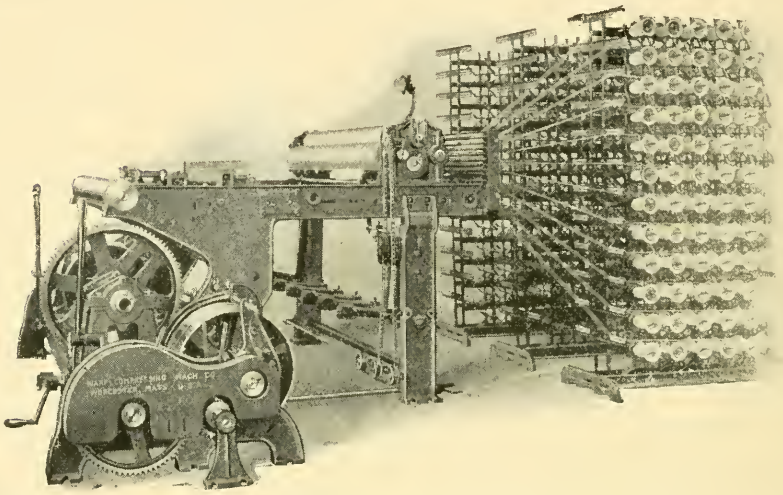
We make a specialty of difficult cotton packaging Let us know your wants

WARP COMPRESSING MACHINE CO.

WORCESTER, MASS.

Specialists in

SPOOLING AND BEAMING MACHINERY



DIRECT BEAMING OUTFIT FOR PLIED COTTON YARNS

Making warps directly from twister-spools or cheese-packages to loom beam. For automobile tire fabrics, light and heavy duck, sail-cloth, woven belting, asbestos goods, etc.

Cotton Machinery: Standard, Heavy & Extra-heavy weights
Direct Beaming Outfits
Dry Slasher Outfits
Chain Beaming Outfits
Warper Creels

Woolen Machinery:
Warp Compressors
Wool Beamers
Dry Dressers
Jack Spool Creels
Compressing Spoolers

Worsted Machinery:
Warp Compressors
Heavy Duplex Beamers
Royal Worsted (Single drum) Inspecting Spoolers
Multiple 6 Drum Compressing & Inspecting Spoolers
Multiple 3 Drum Compressing & Inspecting Spoolers
Multiple 3 Drum Beam Spoolers

CHAPMAN MANUFACTURING CO.

WINCHESTER, MASS.

CHAPMAN BALL-BEARING SPINDLES

are practically frictionless and therefore *must* spin uniformly. There is no drag from heating journals nor gumming oil, so the twist *must* be even; there *must* be fewer broken ends, there *must* be less, or no, soft yarn; and there can be no oil=stained yarn.

This perfect regularity of product *must* result in more and better yarn.

As for Power: place your hand on a rail of Chapman Ball=Bearing Spindles—it is *cool*. Try it during a sudden shower—it is *still* cool! This single demonstration should settle the power question forever.

We prevent waste—stay depreciation—reduce operating costs, insure maximum product, reduce friction to the vanishing point, meet all speeds with equal efficiency, prevent soft and oil=stained yarn, reduce broken ends: and spin more uniform and more elastic yarn. The first saving we make is Power—all the other benefits *must* follow our frictionless spindle.

There is no spinning condition too severe for the durability and efficiency of CHAPMAN BALL=BEARING SPINDLES

STEEL HEDDLE MANUFACTURING COMPANY

21st & Allegheny Ave., Philadelphia, Pa.
EASTERN OFFICE, 76 Dorrance Street, Providence, R.I.
SOUTHERN OFFICE, 111 Washington Street, Greenville, S.C.

FLAT STEEL HEDDLES AND UNIVERSAL FRAMES

A large percentage of Manufacturers realize the great importance of the Steel Heddle which has become a standard equipment in most of the mills and is used today universally on most all classes of goods which are manufactured in this country, Canada, Japan, or China.

The Universal Frame is used in hundreds upon hundreds of Textile Mills. Why? Because it is built for service—for efficiency—for durability. It is built for real economy. You can have the **Universal Frame** built to fit the peculiar conditions of your mill and your product.

COTTON, SILK, WORSTED or WOOL
There is a Heddle and Frame for the Work

From fancy cotton shirtings to canvas—from narrow fabrics to broad silk—from light worsteds to heavy woolen cloths, there is a heddle and frame for your particular kind of work.

We are manufacturers of the best *doup heddle* the market ever produced. We are makers of the best finished drop heddles and wires you ever had in your mill.

The "Made in America" cast steel Reed Wire, for all kinds of Reeds, is made in our plant.

These are facts.

Do you want a list of users in your particular line?

Write to these people yourself.

They'll tell you what Steel Heddle Equipment has done for them.

SOUTHERN SPINDLE AND FLYER COMPANY, Inc.

CHARLOTTE, NORTH CAROLINA

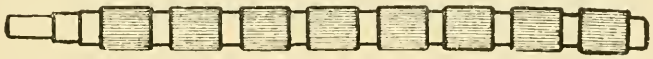
W. H. Monty,
President and Treasurer

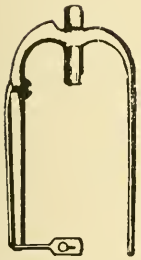
W. H. Hutchins,
Vice-President and Secretary

TEXTILE MACHINERY

Manufactured, Overhauled and Repaired

The Only Flyer Presser Manufacturers in the South



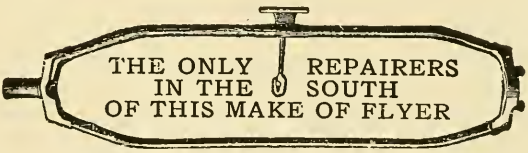


WE MANUFACTURE

Steel Rolls, Flyer Pressers, Card Room Spindles, etc.

WE REPAIR

Steel Rolls, Spindles and Flyers of All Kinds, Picker Lap Pins, etc.



WE OVERHAUL AND REARRANGE

Card Room Frames, Spinning Frames, Twisters, Spoolers, etc.

SHAMBOW SHUTTLE COMPANY

WOONSOCKET, R.I.

SHUTTLES OF EVERY DESCRIPTION

Guaranteed Shuttles Made to Your Specifications and a Service That Will Meet Your Requirements

No. 17869
Cop and Bobbin Shuttle with Ear Clips and Patented Hand-Threader, Enameled. For Powder Bag Fabric. Dogwood. Right Hand.

We are organized so that you may have your choice of

1st. A shuttle made to your own design as regards size, fittings, cuts, etc., or

2d. A lowest-first-cost shuttle, or

3d. An exact duplicate of what you are now using, or

4th. The most efficient shuttle our experts can design for keeping your looms weaving most continuously. A big producer of quality cloth at low ultimate shuttle and weaving costs.

These four types are made in Persimmon or Dogwood. You thus have eight kinds you can choose from.

Differences in design alone represent the difference in cost. Quality of timber, assembled parts and workmanship are guaranteed to be of the highest standard.

We will be very glad to fill your order for any one, or two, or three, or all four styles so you may judge what is best for you.

We do everything possible to meet your requirements. Your regular or rush order will receive the attention your needs demand. We are satisfactorily serving a great many weavers working on government orders.

E. H. JACOBS MFG. CO.

DANIELSON, CONN.

ESTABLISHED 1869

JACOBS LOOM SUPPLIES

(All Trade Names Registered and Products Patented)

Jacobs Patented Verybest Lug Straps
Jacobs Patented Roller Cushion Lug Straps
Jacobs Patented Canvasback Lug Straps
Jacobs Patented Pick Arms
Jacobs "Special" Lug Straps
Jacobs "Crescent" Lug Straps
Jacobs "Star" Duck Lug Straps
Jacobs Jerker and Loop Straps
Jacobs Combination of Straps (for silk looms)
Jacobs Canvas Check Straps—plain or reinforced
Jacobs Lug Strap Washers
Jacobs 2 & 3 ply Leather Lug Straps
Jacobs 3 & 4 ply formed & stitched Lug Straps
Jacobs Canvas Hangups
Jacobs Leather Hangups
Jacobs Canvas Connections
Jacobs Canvas Sweepstrap Heads
Jacobs Leather Bunters (for cotton looms)
Jacobs Canvas Bunters (for cotton looms)
Jacobs Canvas Bumpers (tire fabric looms)
Jacobs Canvas Holdups
Jacobs Canvas Loom Strapping
Jacobs Leather Loom Strapping
Jacobs Braided Harness Dobby Cords
Jacobs Round Harness Straps
Jacobs No. 44 and No. 46 XXCY Pickers (for duck looms)
Jacobs No. 27 and No. 37 XXCY Pickers (for cotton looms)
Jacobs B. S. D. (solid die) Pickers (for cotton looms)
Jacobs Jersey Oak Pickers (for cotton looms)
Jacobs Surpass WX Pickers (for cotton looms)
Jacobs No. 44, No. 46, No. 48½ Pickers (for duck looms)
Jacobs Chrome and Oak Pickers (for cotton looms)
Jacobs Canvas and Oak Pickers (for cotton looms)
Jacobs Canvas Box Pickers (carpet and duck looms)
Jacobs Leather Loop Pickers (Draper looms)
Jacobs Patented Bull Nose Pickers (Draper looms)
Jacobs "Verybest" Loop Pickers (tire fabric looms)
Jacobs Leather Box Pickers (for silk looms)
Jacobs "Diamond" Picker Loops
Jacobs Picker Straps (6½″ x ⅞″)
Jacobs Winding Leather scarfed edge

Carried in stock by all of the large supply houses.

FREE SAMPLES TO ANYONE ANYWHERE ON EARTH

WHITINSVILLE SPINNING RING CO.

WHITINSVILLE, MASS.

NATIONAL RING TRAVELER CO.

PROVIDENCE, R.I.

LARGEST AND BEST EQUIPPED MAKERS
SPINNING AND TWISTING TRAVELERS

All NATIONAL TRAVELERS are Packed in Our PATENTED AIR TIGHT CANISTERS

THE PATENTED FLAT TOP TRAVELER assumes an upright position immediately on starting and maintains it. Because of heavier stock used in the Traveler and better distribution of the material, its durability is increased one-third. Two or more sizes heavier can be run because they are lighter on the rings, there is less friction and longer life. Because they do not wear where the thread is guided, less ends break as the Traveler wears.

Send us samples of Traveler with ring you are using and we will send you for trial samples free of cost.

"Particular Makers for Particular Spinners"

FOSTER MACHINE COMPANY

OFFICE AND WORKS AT

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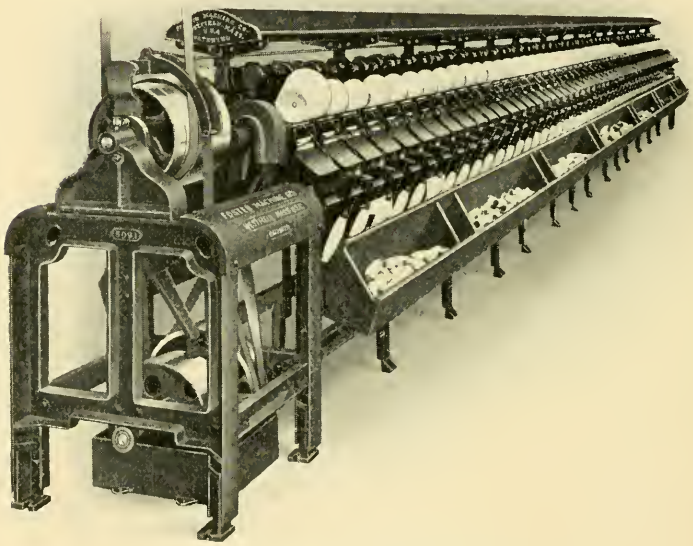
MANUFACTURERS OF

CONE AND TUBE WINDERS AND SPECIAL TEXTILE MACHINES



Model Thirty Cone Winder

Cone Winding and Tube Winding Machines, open wind or precise wind, any length of traverse up to eight inches. Drawing supply from cop, bobbin or spool.

Skein Winding—drawing cotton, wool or worsted from swifts or runners to tube or cone.

Tube Doublers, two to six ends up for twisting supply and wire covering.

The Foster Warp Gassing Machine for singeing yarn in the warp, 378 or more ends at once.

UNIVERSAL WINDING COMPANY

95 South Street, BOSTON, MASS.

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LEESONA
TRADE NAME

We Make
"UNIVERSAL" WINDING MACHINES

for winding filling for broad and narrow looms — cones for knitting — tubes for warps, doubling, wire covering, braiders, thread, twine, cords — electro magnets and specialties.

ASHWORTH BROS., Inc.

FALL RIVER, MASS.

WORCESTER, MASS. PHILADELPHIA, PA. CHARLOTTE, N.C.
GREENVILLE, S.C. ATLANTA, GA.

MANUFACTURERS OF

CARD CLOTHING
OF EVERY DESCRIPTION

Top Flats Reclothed
Lickerins Repaired

All of our Branches are equipped with machinery for this work and carry a stock of Card Clothing for prompt delivery

HOWARD BROS. MFG. CO.

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CARD CLOTHING

FOR ALL CARDS

1866 — 1918

52 YEARS OF CONTINUAL GROWTH

BARBER MANUFACTURING CO.

LOWELL, MASS.

SPINNING TAPE SPECIALISTS

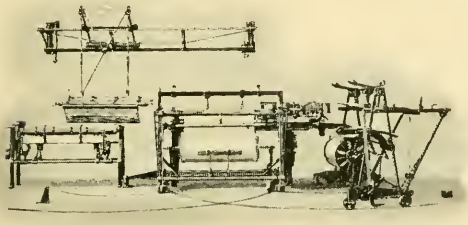
THE LEADING MANUFACTURERS of all kinds of machinery tapes for cotton, worsted, jute, flax, and silk spinning and twisting machinery.

BARBER-COLMAN COMPANY

BOSTON, MASS. GREENVILLE, S.C.

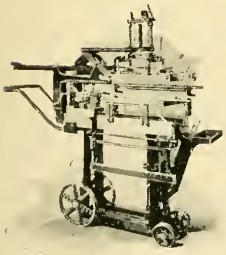
MAIN OFFICE AND FACTORY
ROCKFORD, ILL.

WARP TYING MACHINES, HAND KNOTTERS, GEAR HOBBING MACHINES, HOBS FOR CUTTING SPUR AND SPIRAL GEARS—SPROCKETS —WORM WHEELS, CARBON AND HIGH SPEED STEEL MILLING CUTTERS, SIDE MILLING CUTTERS, METAL SLITTING SAWS, ANGULAR CUTTERS, END MILLS, INSERTED TOOTH CUTTERS, INVOLUTE GEAR CUTTERS AND FORMED CUTTERS WHICH CAN BE SHARPENED WITHOUT CHANGING THE FORM.



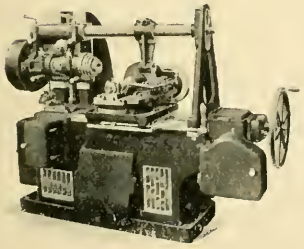
Warp Tying Machine—Model E

A machine that will produce in ten hours as much work as can be done by fifteen drawing-in hands, accurate to the last degree, a labor saver and dividend payer.



Warp Tying Machine Model K

A portable machine, for tying-in behind the loom. It handles a wide range of work such as ducks, tire fabrics, towellings, damasks, crochet and satin quilts, double beam work, blankets, corduroys, fancy worsteds, velvet, plush, tapestry. Reduces tying-in or twisting-in cost and idle loom time.



No. 12 Gear Hobbing Machine

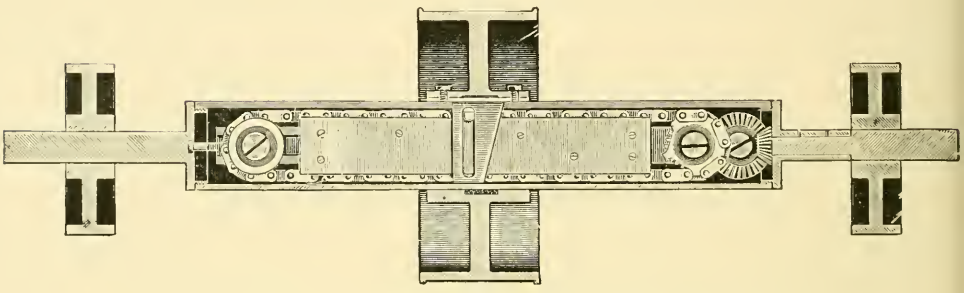
A manufacturing machine for heavy duty work. This machine has been developed to cut with the greatest degree of accuracy the range of sizes in spur and spiral gears that are commonly met with in general practice.

B. S. ROY & SON CO.

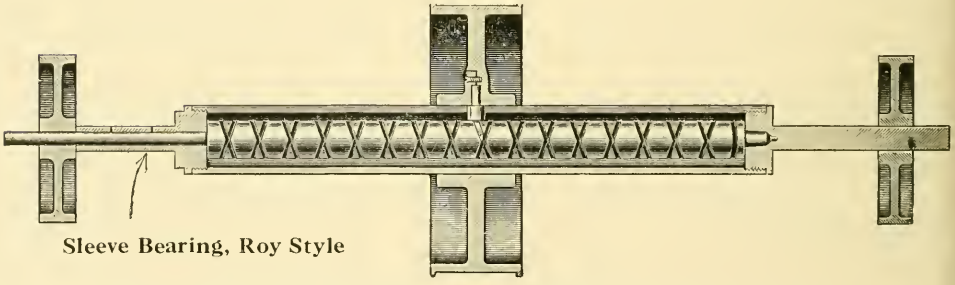
ESTABLISHED 1868

WORCESTER, MASS.

TEXTILE GRINDING MACHINERY



Sectional View of Roy Chain Traverse Grinder for Napper Rolls



Sectional View of Roy-Hardy Screw Traverse Grinder for Cotton Cards

We specialize in grinders for all makes of cards, garnets, calenders, and nappers.

Write for Circulars

PAULSON, LINKROUM & CO., INC.

87 AND 89 LEONARD STREET, NEW YORK, U.S.A.

PHILADELPHIA CHICAGO

COTTON YARNS

OF EVERY DESCRIPTION

FOR

WEAVING AND KNITTING

WE SPECIALIZE IN
COTTON YARNS
FOR EXPORT

THE J. R. MONTGOMERY CO.

WINDSOR LOCKS, CONN.

MERCERIZED COTTON WARPS

Showing Highest Possible Silk Lustre

High Grade Cotton Warps and Novelty Yarns,

Tinsel and Metal Thread

PRINTERS OF COTTON, WOOL, AND WORSTED YARNS

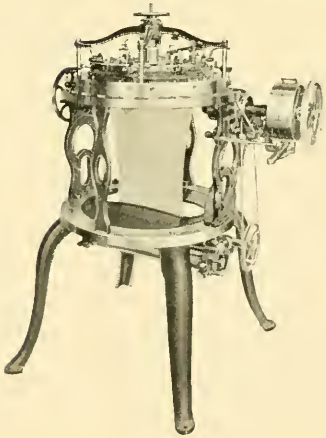
ESTABLISHED 1865

SCOTT & WILLIAMS

INCORPORATED

366 BROADWAY, NEW YORK

OUR KNITTING MACHINERY



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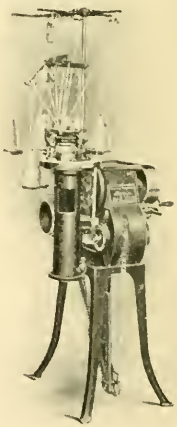
and

UNDERWEAR

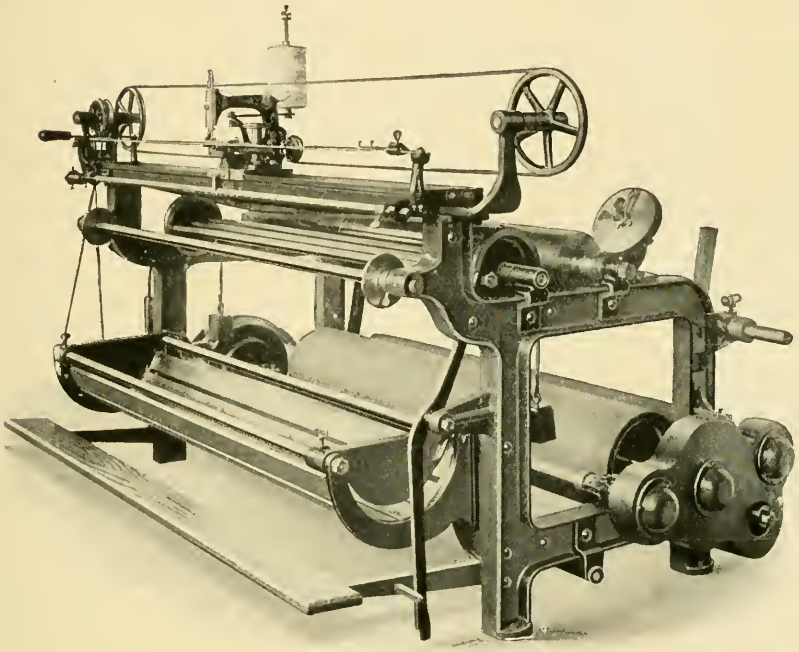
Will give you higher quality merchandise, greater production, and lower cost.



DINSMORE MANUFACTURING CO.

SALEM, MASS.

SEWING MACHINES



No. 4 Opening, Sewing, and Re-rolling Railway Machine, showing Measuring Roll Dinsmore or Singer Type Head as preferred

RAILWAY AND ROTARY MILL SEWING MACHINES

An absolutely perfect system for joining the ends of cloth to make a continuous piece for all of the various methods of finishing. Thirteen styles.

Send for *Illustrated Catalogue*.

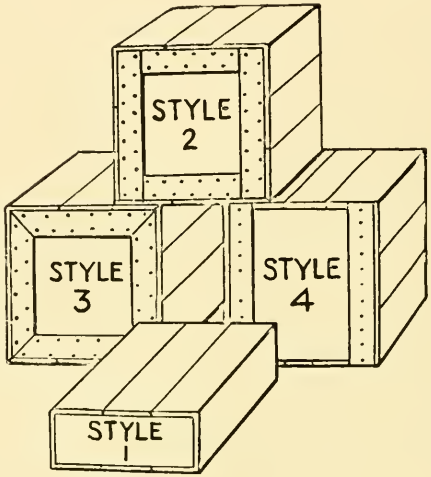
CHAFFEE BROTHERS COMPANY

OXFORD, MASS.

BOXES, CLOTH BOARDS

ESTABLISHED 1883 INCORPORATED 1900

CARLOAD LOTS A SPECIALTY



22 YEARS MANUFACTURING

CLOTH BOARDS

OF THREE KINDS

PATENT, WOOD, PAPER

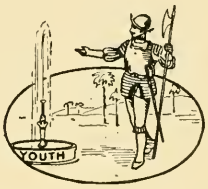
THIS BOARD IS ESPECIALLY DESIGNED TO DISPLAY YOUR TRADE MARK
THIS BOARD IS ESPECIALLY DESIGNED TO DISPLAY YOUR TRADE MARK

SAMPLES AND PRICES FURNISHED UPON REQUEST

H. W. BUTTERWORTH & SONS CO.

ESTABLISHED 1820

PROVIDENCE OFFICE, TURK'S HEAD BLDG. PHILADELPHIA



WE are the oldest in years among American manufacturers of machinery for finishing all classes of textile fabrics, but we enjoy "perpetual youth."

We are ever alive to new conditions, and are constantly experimenting to endeavor to make our machines and processes even more efficient and economical.

FINISHING
Butterworth
MACHINERY

THE TEXTILE-FINISHING MACHINERY CO.

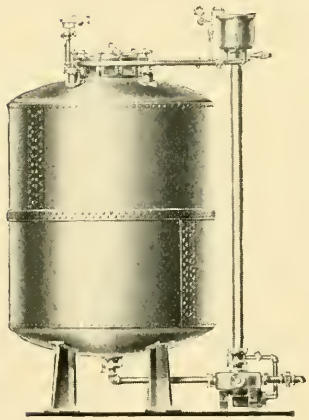
MAIN OFFICE AND WORKS
PROVIDENCE, R.I.

NEW YORK OFFICE
30 CHURCH STREET

MACHINERY

FOR

BLEACHING, DYEING, DRYING, MERCERIZING AND FINISHING



KIERS

WITH

RUSDEN PATENT CIRCULATOR AND SUPERHEATER

Rapid boiling and automatic circulation assured without danger of damage from stops, as there are no running parts such as belts, pumps or motors to get out of order. As long as the steam supply continues, **circulation is SURE.**

KHAKI DYEING MACHINERY

WARP MERCERIZING MACHINERY

DRYING MACHINES

ROLLS FOR CALENDERS AND MANGLES

of

COTTON, HUSK, PAPER AND COMBINATION

THE PHILADELPHIA TEXTILE MACHINERY COMPANY

Builders of Drying Machinery

Philadelphia, Pa.

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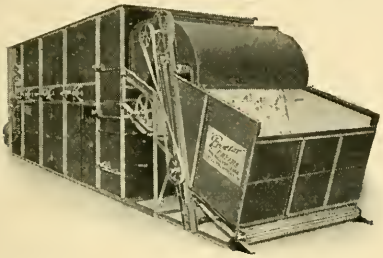

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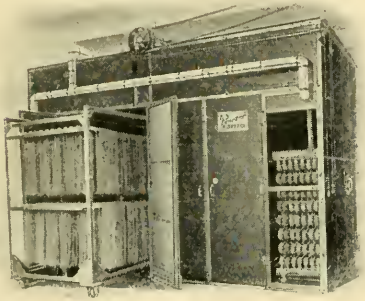

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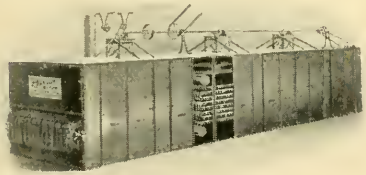

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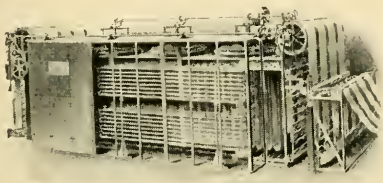

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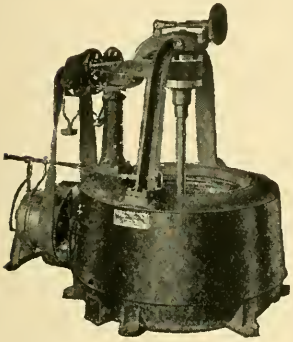

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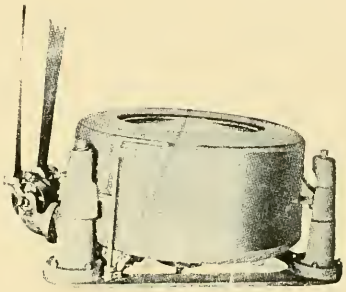

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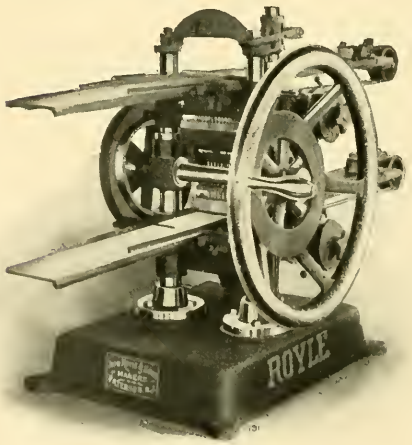

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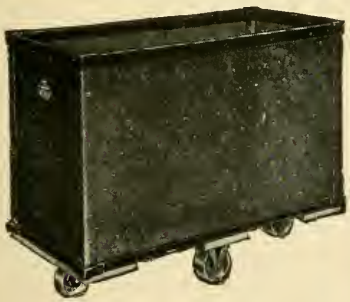

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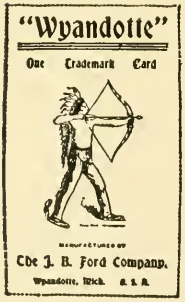

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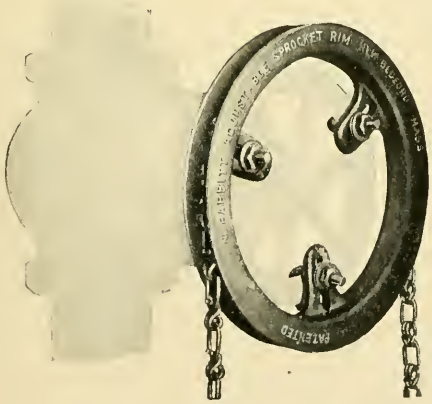

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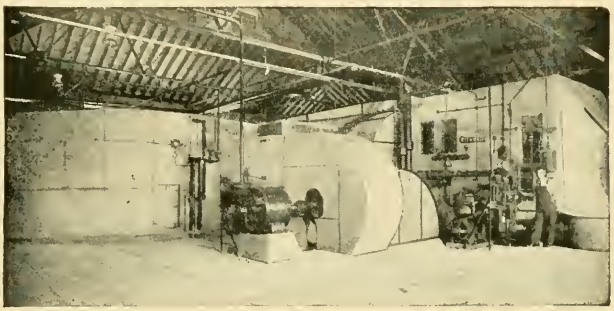

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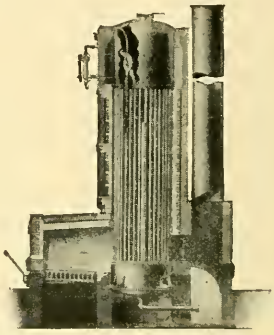

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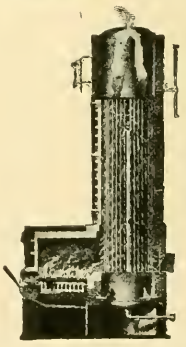

Consider carefully steam quality:—

Did you ever wreck an engine by pulling water over into it from the boiler? Study this boiler. The steam drum gives great height from water line to steam outlet nozzle. This height provides room for separation of the steam from the water which is entrained with it at a point close to the surface of liberation. Since the shell is subject to a mild degree of heat some superheat is effected on the steam leaving this boiler. *You do not pull water over from this boiler.*

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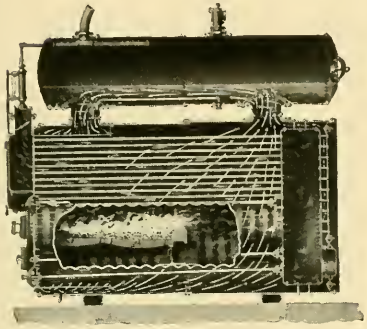

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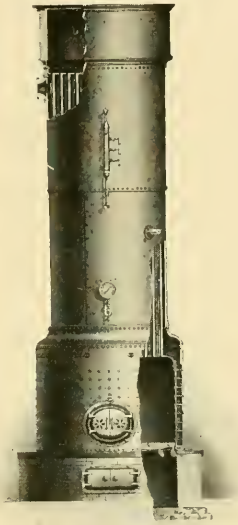

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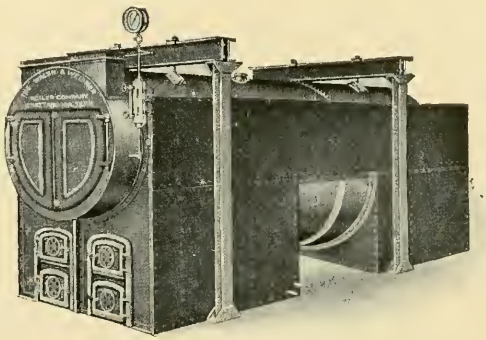

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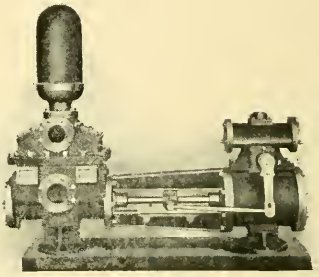
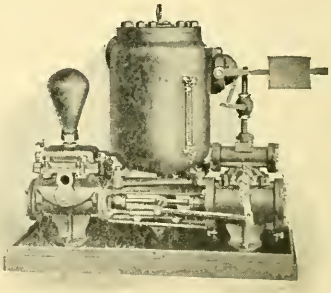
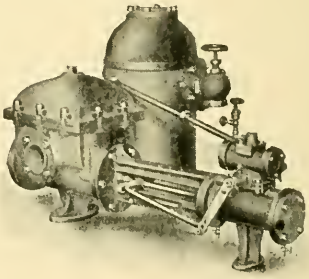


Davidson Pressure Pump



Davidson Automatic Pump and Receiver



Davidson Air Pump and Jet Condenser

THE NATIONAL PIPE BENDING CO.

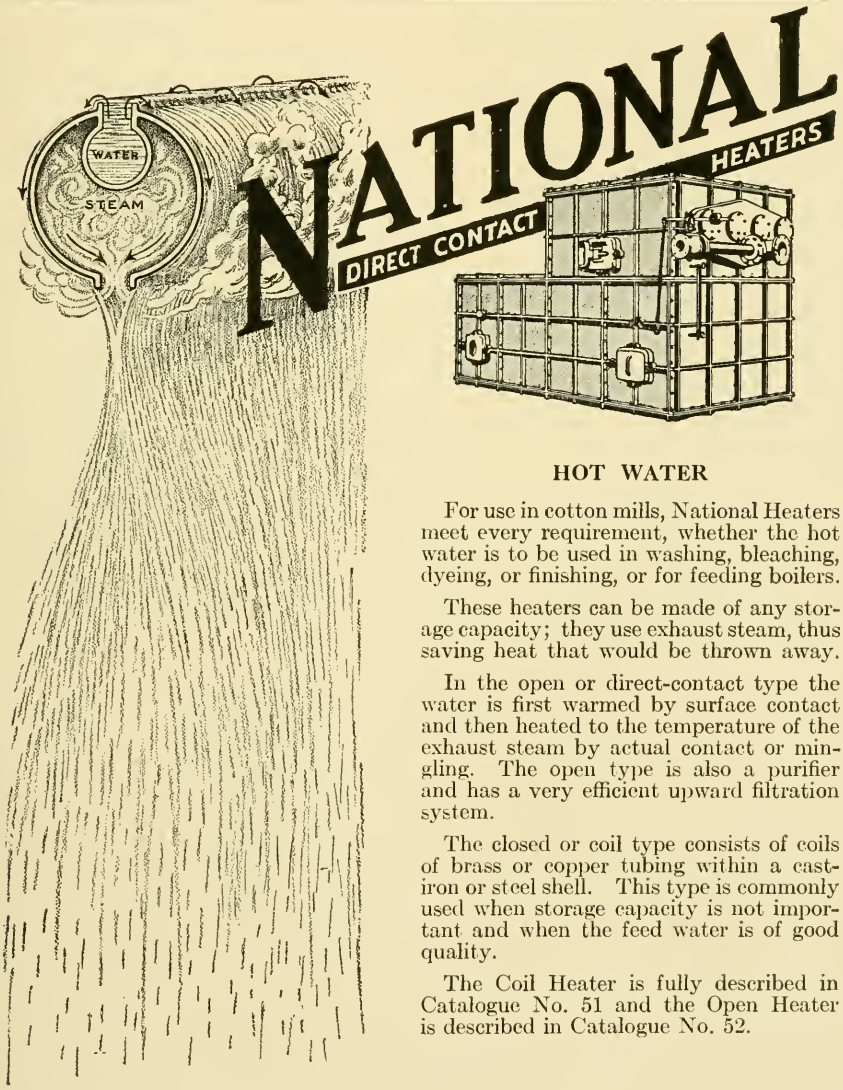
Main Office and Works

NEW HAVEN, CONN.

Represented by

Ruggles-Klingemann Mfg. Co.	James S. Hamilton Co.	H. W. Reisinger	L. C. Holmes
10 High St.	149 No. 7th St.	710 Park Bldg.	705 Ouray Bldg.
Boston, Mass.	Philadelphia, Pa.	Pittsburgh, Pa.	Washington, D.C.

THE NATIONAL COIL OR CLOSED FEED-WATER HEATER. THE NATIONAL DIRECT CONTACT FEED-WATER HEATER AND PURIFIER. NATIONAL STORAGE HEATERS, NATIONAL STEAM AND OIL SEPARATORS, COILS AND BENDS OF IRON, BRASS AND COPPER PIPE.



HOT WATER

For use in cotton mills, National Heaters meet every requirement, whether the hot water is to be used in washing, bleaching, dyeing, or finishing, or for feeding boilers.

These heaters can be made of any storage capacity; they use exhaust steam, thus saving heat that would be thrown away.

In the open or direct-contact type the water is first warmed by surface contact and then heated to the temperature of the exhaust steam by actual contact or mingling. The open type is also a purifier and has a very efficient upward filtration system.

The closed or coil type consists of coils of brass or copper tubing within a cast-iron or steel shell. This type is commonly used when storage capacity is not important and when the feed water is of good quality.

The Coil Heater is fully described in Catalogue No. 51 and the Open Heater is described in Catalogue No. 52.

B. F. STURTEVANT COMPANY

HYDE PARK, BOSTON, MASS.

AND ALL PRINCIPAL CITIES OF THE WORLD

FANS, BLOWERS, HEATING AND VENTILATING APPARATUS, PNEUMATIC CONVEYING SYSTEMS, MECHANICAL DRAFT APPARATUS, FUEL ECONOMIZERS, STEAM TURBINES, STEAM ENGINES, GENERATING SETS, MOTORS, EXHAUSTERS, PROPELLER FANS, ETC.

Sturtevant
(REG. U.S. PAT. OFF.)

POWER APPARATUS

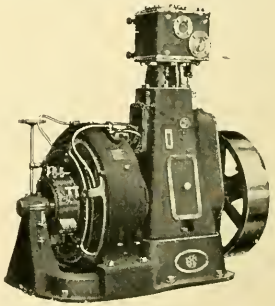
FUEL ECONOMIZERS

Sturtevant Fuel Economizers effect savings of from 8 to 20% in fuel. They increase boiler capacity, purify feed water, supply large amounts of hot water for manufacturing purposes, and intercept large amounts of sludge that would otherwise form scale in the boilers. Since the water is heated by waste flue gases, the saving is a net profit.

Sturtevant Fuel Economizer

MECHANICAL DRAFT APPARATUS

Mechanical draft increases boiler capacity, is independent of weather, enables peak loads to be handled with ease, and permits the use of low-grade fuels. Systems can be supplied for every size and type of plant.

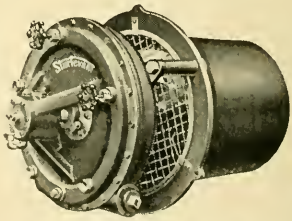


Sturtevant Vertical Engine Generating Set.—Made in sizes up to 100 KW.—Engines furnished separately if desired

PRIME MOVERS

Sturtevant Engines, Turbines and Electric Motors are furnished either separately or in connection with fans and generating sets.

Catalogues on Request.—There are special catalogues on each type of Sturtevant apparatus and these will be sent on request.



Sturtevant Turbo Undergrate Blower for supplying forced draft to small boilers

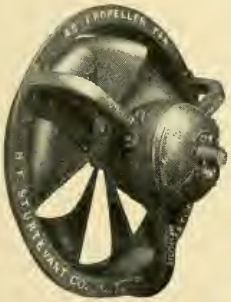
B. F. STURTEVANT COMPANY

HYDE PARK, BOSTON, MASS.

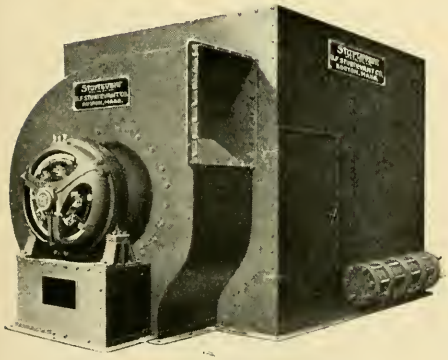
AND ALL PRINCIPAL CITIES OF THE WORLD

FANS, BLOWERS, HEATING AND VENTILATING APPARATUS, PNEUMATIC CONVEYING SYSTEMS, MECHANICAL DRAFT APPARATUS, FUEL ECONOMIZERS, STEAM TURBINES, STEAM ENGINES, GENERATING SETS, MOTORS, EXHAUSTERS, PROPELLER FANS, ETC.

Sturtevant Autoforce Ventilator



Sturtevant Propeller Fan



Sturtevant Fan and Heater—Electric Drive

Sturtevant (REG. U.S. PAT. OFF.)

HEATING AND VENTILATING APPARATUS

The Sturtevant Fan System of heating and ventilating is ideal for cotton mills. It provides heating and ventilating in the winter and cooling in the summer. Furthermore automatic control of temperature and humidity can be secured if desired.

With the Sturtevant system in a dyehouse or bleachery, fog, vapor, condensation and the other attendant evils are entirely eliminated.

AUTOFORCE VENTILATORS AND PROPELLER FANS

Sturtevant Propeller Fans and Autoforce Ventilators are ideal for many ventilating requirements. They remove hot air, fog and vapor, and improve working conditions.

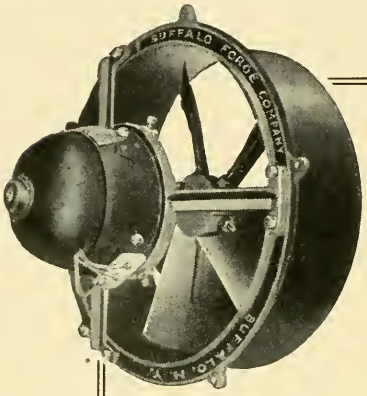
CONVEYING COTTON BY FANS

Sturtevant Fans are very largely used for conveying cotton from one part of the mill to another. This method of transportation is rapid and economical. It avoids much labor in handling material, eliminates hand trucks, occupies no available floor space, and makes a very substantial saving in operating cost.

Catalogues.—Our Catalogues Nos. 227, 230 and 235 are of interest to every cotton manufacturer.

BUFFALO FORGE COMPANY

BUFFALO, NEW YORK



Remove the Steam

One of the most troublesome things in the dye-house is steam. Why not get rid of it with a simple inexpensive

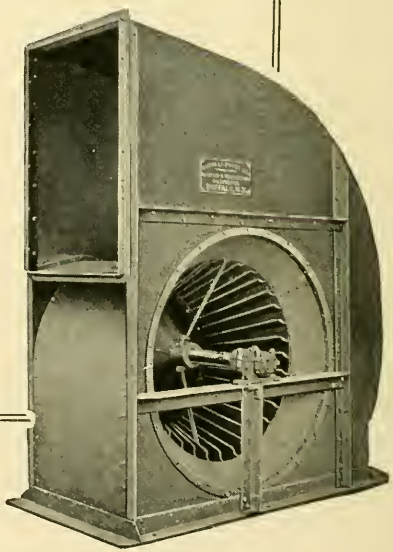
Buffalo Disc Fan

Buffalo Disc Fans are low in first cost, easily installed, and economical to operate.

Heating and Ventilating

For more complex systems of heating, ventilating and humidity control consult our Engineering Department — they are at your service and guarantee results.

Catalog 198 contains complete data on heating and ventilating systems.



WESTINGHOUSE ELEC. & MFG. CO.

EAST PITTSBURGH, PA.

Westinghouse
Motor Drive

If your mill drives have not kept up with the demand for increased production, it will pay you to investigate WESTINGHOUSE MOTOR DRIVES.

WESTINGHOUSE SERVICE is based on fifteen years' experience in designing, building, and testing electrical equipment for textile mills.

Westinghouse Electric & Mfg. Co.

EAST PITTSBURGH, PA.

W
WESTINGHOUSE ELECTRIC

MORSE CHAIN CO.

Boston	Main Office and Works	Greensboro
141 Milk Street	ITHACA, N.Y.	N.C.

Atlanta, Earl F. Scott, M. E. 702 Chandler Bldg.
Chicago, Merchants L. & T. Bldg.
Cleveland, 421 Engineers Bldg.
Detroit, 1003 Woodward Ave.
Kansas City, Mo., Morse Engrg. Co., Long Bldg.
Minneapolis, Strong-Scott Mfg. Co., 413 3rd St.
New York, 50 Church St.
Pittsburgh, Westinghouse Bldg.
St. Louis, Morse Engrg. Co., Chemical Bldg.
San Francisco, Monadnock Bldg.
Jones & Glassco, Reg'd Montreal and Toronto, Canada

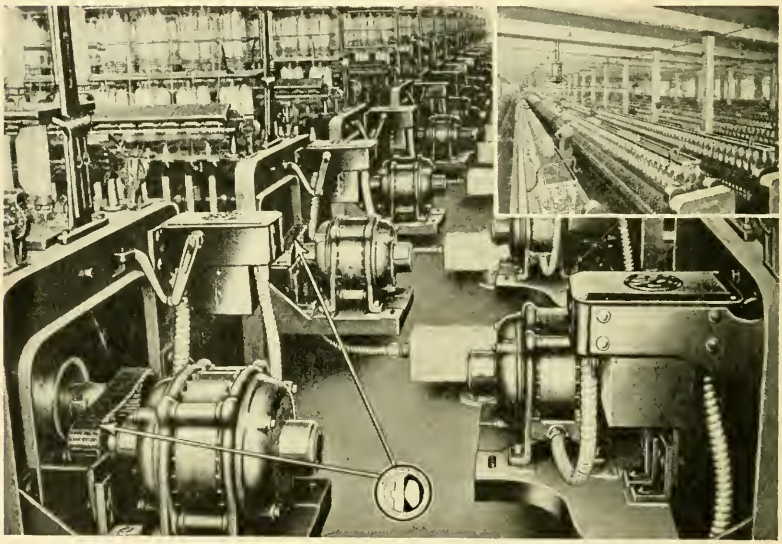
MORSE SILENT CHAIN DRIVES

The Chain with the ROCKER JOINT

COMPACT—DURABLE—EFFICIENT

Special information and estimates furnished for any application

Send for Textile Bulletins



Cotton Spinning Room with Frames Driven by Individual Motors through Morse Silent Chain Drives

MORSE CHAIN CO.

MAIN OFFICE AND WORKS
ITHACA, N.Y.

BOSTON
141 MILK STREET

GREENSBORO
N.C.

MORSE SILENT CHAIN DRIVES

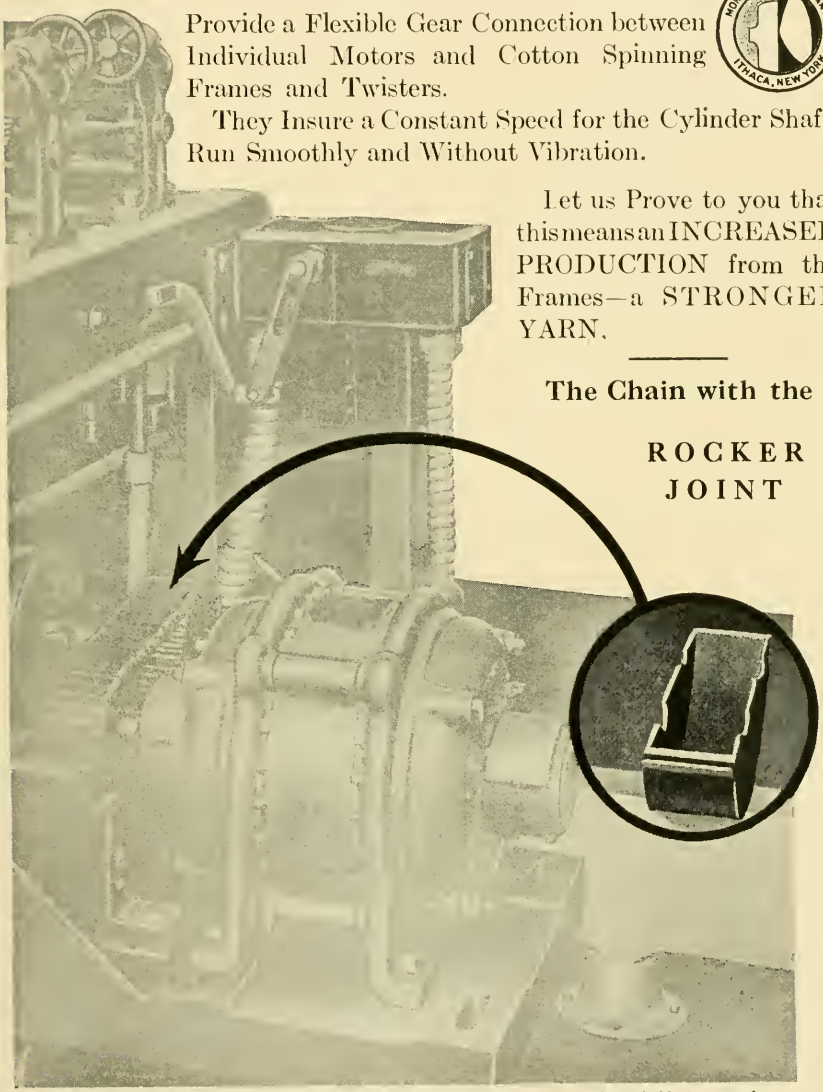
Provide a Flexible Gear Connection between Individual Motors and Cotton Spinning Frames and Twisters.

They Insure a Constant Speed for the Cylinder Shaft, Run Smoothly and Without Vibration.

Let us Prove to you that this means an INCREASED PRODUCTION from the Frames—a STRONGER YARN.

The Chain with the

ROCKER JOINT



End View of Cotton Spinning Frame with 5 H. P. Individual Motor and Morse Silent Chain Drive.

THE GRATON & KNIGHT MFG. CO.

WORCESTER, MASS.

Boston	Philadelphia	New Orleans
Fall River	Chicago	St. Louis
Cleveland	Detroit	Portland
Pittsburgh	Kansas City	Seattle
New York	Minneapolis	Montreal
	Atlanta	Leicester, England

SELLING AGENTS

The Graton & Knight Mfg. Co. of California, San Francisco, Cal.
The Graton & Knight Mfg. Co. of Wisconsin, Milwaukee, Wis.
The Graton & Knight Mfg. Co. of Texas, Dallas, Tex.

OAK LEATHER TANNERS AND MAKERS OF LEATHER BELTING, LACE LEATHER, PACKINGS, STRAPPINGS, PICKER LEATHER, PICKERS, AND LEATHER SPECIALTIES

STANDARDIZED SERIES BRANDS OF LEATHER BELTING

Heart **GraKnight** **GraKnight Dynamo**

All made from choice packer steer hides thoroughly tanned by the long time oak bark process in our own factory, scientifically curried and cemented into belting unequaled in durability and strength. These brands differ only in weight, each being made from guaranteed first quality center stock.

Spartan. Special waterproof, steamproof, and heatproof belting for difficult drives, made from selected stock tanned by our exclusive process.

Neptune. Waterproof leather belting—cut from center stock of finest oak tanned leather. Absolutely impervious to moisture.

Spar Oak. Manufactured from a combination of selected oak and Spartan leather, possesses unusual strength and firmness, together with great pliability.

LEATHER SPECIALTIES

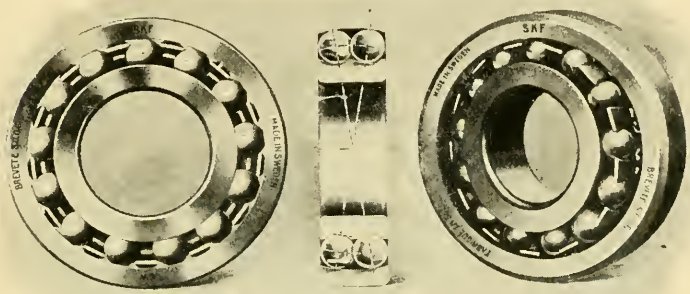
Dobby Straps	**Loom Strapping**	**Rub Roll Aprons**
Gaskets	**Lug Strapping**	**Textile Straps**
Harness Straps	**Mill Strapping**	**Twist Belting**
Jack Straps	**Picker Leather**	**Washers**
Leather Packings	**Round Belting**	**Check Strap**

All our specialties are made from stock selected after long experience as best suited for the work which it is to perform. We will gladly quote on your requirements. Send samples for prices and delivery—catalogue upon request.

S K F BALL BEARING COMPANY

HARTFORD, CONN.

SELF-ALIGNING RADIAL, ADAPTER AND THRUST BALL BEARINGS; AND SELF-ALIGNING SHAFT HANGERS AND PILLOW BLOCKS.

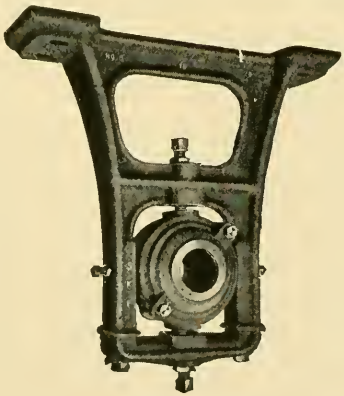


S K F RADIAL BALL BEARINGS

have the exclusive feature of self-alignment. The inner surface of the outer race is a section of a hollow sphere whose center is on the axis of the shaft. The inner race and balls are free to turn in any position within the race—a true ball and socket action. Any deflection or springing of the shaft cannot bind the bearing.

S K F TRANSMISSION EQUIPMENT

This is the S K F Adapter Bearing, mounted in an oil-tight, dust-proof housing and held in drop hanger, post hanger or pedestal pillow block. A rigid pillow block is also made, in which the pillow block itself houses the bearing. No machining of the shaft is necessary in mounting the S K F Adapter Bearing.

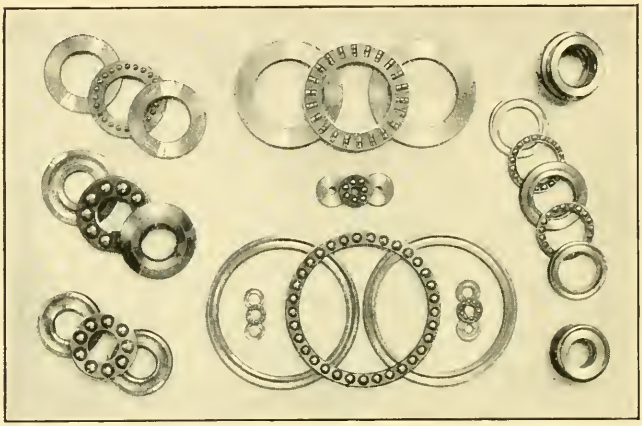


Special catalogues, literature or information gladly furnished for any application.

THE GWILLIAM COMPANY

ENGINEERS
MECHANICAL SPECIALTIES

NEW YORK: 253 W. 58TH ST. AT BROADWAY
BRANCH OFFICE: PHILADELPHIA: 1314 ARCH ST.



Ball Thrust Bearings—All Types **Roller Thrust Bearings**

Dimensions given apply to:—

Ball Thrust Bearings—Collar Type.
Ball Thrust Bearings—Grooved Type.
Roller Thrust Bearings—Collar Type.

Shaft Size	Outside diam.	Thickness	Size Ball	Shaft Size	Outside diam.	Thickness	Size Ball
1/2″	1 7/32″	9/16″	3/16″	2″	3 11/32″	13/16″	5/16″
9/16″	1 7/32″	9/16″	3/16″				
5/8″	1 11/32″	9/16″	3/16″	2 1/16″	3 11/32″	13/16″	5/16″
11/16″	1 11/32″	9/16″	3/16″	2 1/8″	3 19/32″	13/16″	5/16″
3/4″	1 15/32″	9/16″	3/16″	2 3/16″	3 19/32″	13/16″	5/16″
13/16″	1 15/32″	9/16″	3/16″	2 1/4″	3 23/32″	13/16″	5/16″
7/8″	1 27/32″	5/8″	1/4″	2 5/16″	3 23/32″	13/16″	5/16″
15/16″	1 27/32″	5/8″	1/4″	2 3/8″	3 27/32″	13/16″	5/16″
1″	1 31/32″	5/8″	1/4″	2 7/16″	3 27/32″	13/16″	5/16″
1 1/16″	1 31/32″	5/8″	1/4″	2 1/2″	3 31/32″	13/16″	5/16″
1 1/8″	2 3/32″	5/8″	1/4″	2 9/16″	3 31/32″	13/16″	5/16″
1 3/16″	2 3/32″	5/8″	1/4″	2 5/8″	4 11/32″	1″	3/8″
1 1/4″	2 11/32″	5/8″	1/4″	2 11/16″	4 11/32″	1″	3/8″
1 5/16″	2 11/32″	5/8″	1/4″	2 3/4″	4 15/32″	1″	3/8″
1 3/8″	2 15/32″	5/8″	1/4″	2 13/16″	4 15/32″	1″	3/8″
1 7/16″	2 15/32″	5/8″	1/4″	2 7/8″	4 19/32″	1″	3/8″
1 1/2″	2 19/32″	5/8″	1/4″	2 15/16″	4 19/32″	1″	3/8″
1 9/16″	2 19/32″	5/8″	1/4″	3″	4 23/32″	1″	3/8″
1 5/8″	2 31/32″	13/16″	5/16″	3 1/4″	4 31/32″	1″	3/8″
1 11/16″	2 31/32″	13/16″	5/16″	3 1/2″	5 7/32″	1″	3/8″

Many other sizes not listed. When ordering, specify size and type.

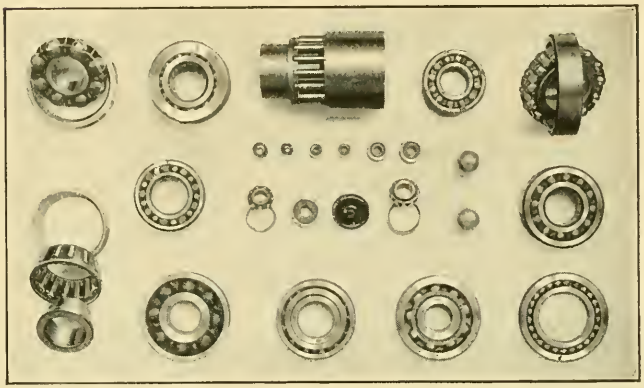
THE GWILLIAM COMPANY

ENGINEERS
MECHANICAL SPECIALTIES

NEW YORK: 253 W. 58TH ST. AT BROADWAY
BRANCH OFFICE: PHILADELPHIA: 1314 ARCH ST.

BALL AND ROLLER BEARINGS

English (Inch) and Metric Dimensions
Types of Bearings in Stock or To Order



Annular Ball Bearings
(English Ball Journal)
Single and Double Row
Journal Roller Bearings

Taper Roller Bearings
Standard
Pressed Steel Bearings
All Types

Sole U. S. Distributors for Bowden Wire, Ltd., England

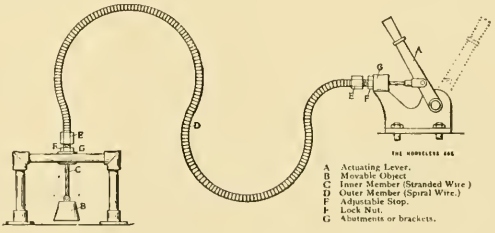
BOWDEN PATENT WIRE MECHANISM

Bowden Wire Mechanism consists mainly of two parts—a closely coiled and practically incompressible spiral wire, constituting what is termed "the outer member," and a wire cable, practically inextensible, threaded through the above, and termed "the inner member."

WHAT IT DOES: The Bowden Wire Mechanism dispenses with all the difficulties of the usual mechanical method of transmitting power in other than a straight line, while enabling power to be transmitted by a tortuous route. The Mechanism is complete in itself, and requires only that one member shall be anchored to a stop at each end, and that the other member shall be attached to an operating lever at one end and to the object to be moved at the other.

ADAPTED THROUGHOUT THE WORLD TO

Aircraft Controls
Motorcycle Controls
Electric Switch Controls
Automobile Controls
Locking Devices
Wireless Switches and many other Mechanical Devices.



The Principle Illustrated

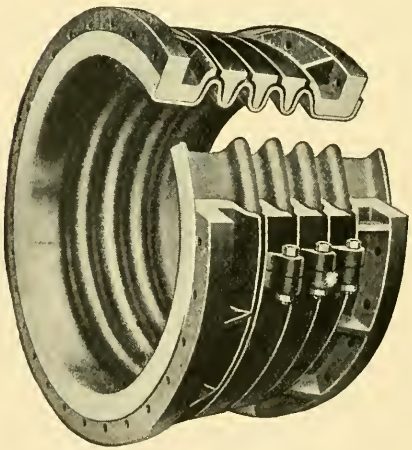
E. B. BADGER & SONS COMPANY

BOSTON, MASS.

EXPANSION JOINTS FOR PIPE LINES, DYE KETTLES, METAL WINDOWS

BADGER SELF-EQUALIZING EXPANSION JOINT

To absorb the strain caused by the expansion and contraction of pipe lines requires some form of expansion joint. In practically all departments of engineering some devices are more simple than others, some require less care, some take up less room. So it is with expansion joints, the sliding or the slip joint requires packing and it is liable to leak if not attended to frequently. The pipe bend is bulky if the change of length amounts to much.



Badger Self-Equalizing Expansion Joint

The Badger Self-Equalizing Expansion Joint is a one piece copper joint. It requires no packing, no attention. It automatically takes care of all strain due to the expansion and contraction. It is small—of no greater diameter than standard pipe flanges.

This joint which conforms to the highest standards of up-to-date engineering is made from one piece of copper corrugated to have the elasticity for the repeated changes of shape and made abundantly strong by the cast iron or steel external equalizing rings which distribute the expansion equally among all corrugations so that no one will have to do more than its share of the work.

The standard form has four corrugations and three equalizing rings; this form has been found most satisfactory. But special sizes and designs are made to meet unusual conditions.

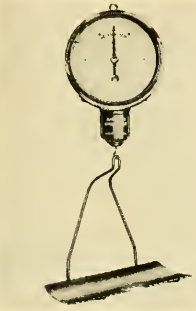
AMERICAN KRON SCALE CO.

430 East 53rd St., New York, N.Y.

10 High Street, Boston, Mass.

58 East 11th Street, Chicago, Ill.

746 Reservoir St., Baltimore, Md.
610 Union Bldg., Cleveland, O.
16 E. Woodbridge St., Detroit, Mich.
405 Urban Bldg., Louisville, Ky.
506 Liberty Bldg., Philadelphia, Penn.
412 Bessemer Bldg., Pittsburgh, Penn.
125 Washington St., Providence, R.I.
Wilson, North Carolina
602 Boston Block, Minneapolis, Minn.

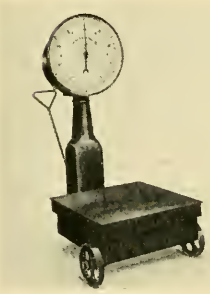


Lap Scale

"LOAD and LOOK" THIS

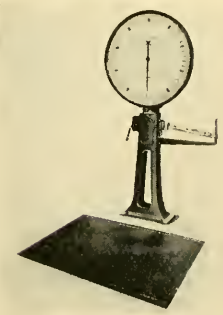
Our Slogan Fully Explains

THE KRON SPRINGLESS DIAL READING LAP SCALE is known to be the most sensitive and durable scale procurable, due to the fact that it has no intermediate levers to interfere with its TRUE gravity principle. The dial indication shows ounces.



Portable Scale

Our **NEW PORTABLE TYPES** are made in various sizes and can be moved about over rough runways without fear of injury due to their special construction.



Dormant Scale

KRON DORMANT SCALES are made in all sizes from 24″ x 24″ to the very largest. All of these types can be equipped with a tare beam; also a Locking Lever Device which greatly lengthens the life of the scale.

ALL KRON SCALES are made of metal and are guaranteed to be ENTIRELY free of springs. The platform bearings are of the suspension interchangeable principle (not rigid).
Literature and full information gladly furnished on request.

NEW YORK AND NEW JERSEY LUBRICANT COMPANY

165 Broadway, New York

ORIGINATORS AND SOLE MANUFACTURERS

TRADE MARK NON-FLUID OIL REGISTERED IN UNITED STATES PATENT OFFICE

NON-FLUID OILS are adapted to nearly all kinds of bearings in textile mills. They not only effect a considerable saving in the cost of lubricants, but reduce the work of oiling and help to increase production by practically abolishing oil stains on goods in process. Following are some of the principal grades designed for textile machinery lubrication.

"A-No. 00": *For comb-boxes, cylinder bearings, licker-in bearings of cards, cams of combing machines and looms.*

Comb-boxes run from 6 to 8 weeks on one filling of "A-No. 00" as against 3 to 6 days with fluid oil. This product does not drip onto floors nor spatter on card clothing and drawing cans like fluid oil. When applying, only enough should be put in box to cover cams; do not fill boxes too full.

"A-No. 000": *For use where a lighter grade than "A-No. 00" is preferred—particularly in ring-oiling shafting, fan and beater bearings of breaker, intermediate and finisher pickers, necks of rolls on sliver and ribbon lap machines, combing machines, drawing frames, roving frames, ring spinning and mule frames and twisters, cylinder bearings of spoolers; on reels and all parts of lower machinery that are oiled by hand with oil cans.*

For spinning room service "A-No. 000" can be used in oil cans but feeds only one drop at a time instead of in a stream like fluid oil, therefore prevents waste and promotes cleanliness. Does not run off bearings like fluid oil, hence need be applied only one third as often. If on filling oil cans with this "A-No. 000" grade it does not feed as many drops per minute as desired, cut off about ¾ of an inch from spout of can to increase the feed; it should discharge at the rate of 40 to 50 drops per minute.

"A-No. 00000": *For use where a lighter grade than "A-No. 000" is desired—especially on bearings of looms, quilling machines, Universal Cone Winders, and ring-oiling bearings of cotton shearing machines.*

"K-No. 00-Special": *For use where a heavier grade than the "A-No. 00" is desired—particularly on cams of combing machines, loom cams, picker rods, picker shoes, picker balls, chain work, loom jackets, ball and roller bearings, nappers, and in oil boxes on heavy machinery and shafting.*

"K-No. 0": *For "heads" of Foster Cone Winders, card cylinder bearings which have slot in cap, and plain bearings of line shafting equipped with funnel cups. Eliminates the dripping of oil onto floors, belts and goods in process.*

"K-No. 0-Special": *For use where a lighter grade than "K-No. 0" is preferred, particularly on main-drive shaft box, bevel gear bearing, cams, and all other moving parts of Foster Cone Winder New Model No. 24.*

"K-No. 000": *For use where a heavier grade than "K-No. 0" is needed, especially in compression cups on bearings of engines, pumps and air compressors; also on loose pulleys, friction clutches, elevator guides, and generally in place of ordinary grease. Lasts much longer and keeps bearings cooler than ordinary grease; also prevents wear better, does not gum, and is not affected by extremes of heat and cold.*

"K-No. 3": *For use in place of tallow on back and bottom rolls of spinning machinery generally.*

"B-No. 25": *For use on gears (all speeds and duty), including bevel, spur, worm and pinion gears.*

WHITE GRADES

For lubricating travelers on twister rings, particularly where wet twisters are employed. These products do not befoul the rings and rails; perceptibly lengthen the life of travelers; cause the work to run better, thus diminishing the number of ends breaking down, and last but not least—largely reduce the percentage of stained yarn.

"K-Extra," "K-X" and **"K-XX"** grades should be applied sparingly in the same manner as tallow mixtures. "K-XXXXX" can be applied with oil cans, being especially prepared for use in this way.

"K-XXXX": For necks of rolls on wet twisters.

CAUTION

NON-FLUID OIL should not be confused with thin grease substitutes that are being put out under similar names. The genuine NON-FLUID OIL is made only by us and the above trade-mark appears on every package. Look for it.

Write for copy of special bulletin "Lubrication of Textile Machinery."

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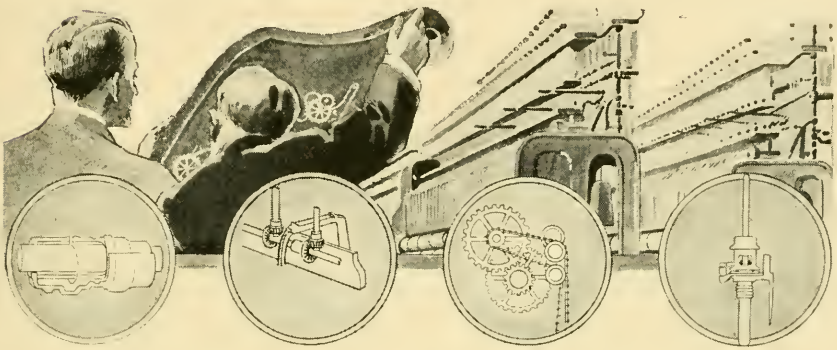
Quality Oil and Grease Products Since 1853



How Much Per Part Per Day?

Machinery is expensive. If a single bearing part runs for only half an hour without proper lubrication, it is damaged. Perhaps it can be repaired — it may have to be replaced. It takes time and labor, to make the necessary adjustments. Overhead continues. In either case, the cost involved is out of proportion to the cost of scientific lubrication — machinery's protectant.

These are the facts. And in the average mill there are thousands of such parts. What is true of one part is just as true of the greater number — except that the results are thousands of times as important.

Men charged with the efficient operation of machinery, agree that the lubricant ideal for textile use must first of all "stay put": it must not climb, drip nor spatter. Further, it must be adhesive, cohesive, tenuous and elastic.

These qualities are necessary to prevent metal-to-metal contact — to really preserve machinery parts—and to reduce to a minimum the item of "spoilage" due to oil-soaked fabrics.

SLO-FLO

Slo-Flo is widely used in textile mills, because it meets these requirements. It was evolved by the S-F Engineering Department, whose 64 years' experience and knowledge are represented in this super-lubricant. Its production entailed in addition to the blending of select crudes, the evolution of a new method — the Acaloric Process, which gives superior heat-absorbing and pressure-resisting abilities to Slo-Flo; makes it non-volatile. Slo-Flo lasts far longer than ordinary lubricants — it saves money.

Slo-Flo is only one of a complete line of scientific specialty and standard products. We will gladly send engineering booklets and other specific information if you will advise us as to the particular requirements of your machinery.

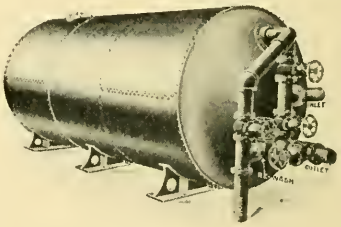
HUNGERFORD & TERRY, INC.

PENNSYLVANIA BUILDING
PHILADELPHIA, PA.

WATER FILTERS AND WATER SOFTENING APPARATUS

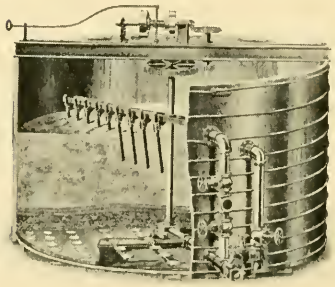
HUNGERFORD Filters provide an ideal method of purifying the water supplies of textile mills. They are made in either the pressure or gravity type to meet any conditions and will render the most contaminated supplies excellent for all manufacturing purposes.

They are especially designed to meet the requirements of the Dyer and Bleacher. They deliver water of remarkable purity, can be safely washed with raw water, occupy a minimum of space and never, if given even reasonable care, require a renewal of the filter bed.



Pressure Filter

The combined daily capacity of these filters now in use in the textile mills in this country is over one hundred and eighty million gallons.



Gravity Filter

A new catalogue just issued gives a complete description of all types of HUNGERFORD Filters together with other information of importance to those interested in water purification. This catalogue will be sent on request.

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Our careful attention to details insures success.

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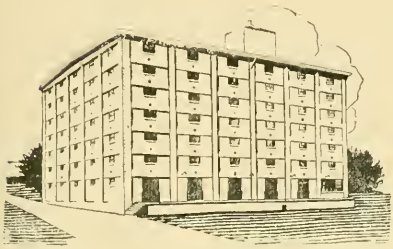

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Killingly, Conn.

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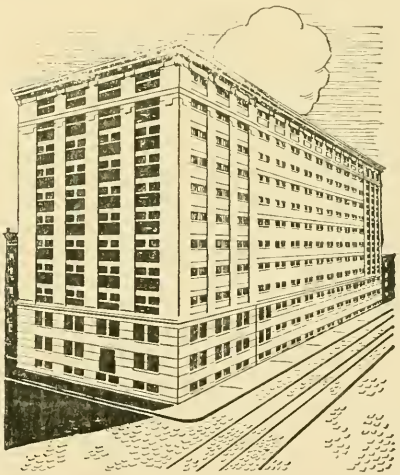
A story a week was the Aberthaw record of construction on this seven-acre storehouse. Concrete fire walls divide the building into four sections and provide 48 separate compartments.



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is used by the carload for brightening up the interiors of cotton mills.

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Easily and permanently tinted, where desired, by mixing with:

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Mill treasurers and agents	13	Textile manufacturing, unassigned	20
Mill superintendents	22	Industrial engineering	19
Mill assistant superintendents	14	Mill engineering	7
Mill foremen of departments	13	Civil engineering	1
Assistants to superintendents	2	Electricians	1
Mill auditors and accountants	3	Trade journalists	4
Mill clerks	1	In business, textile distributing or incidental thereto	4
Second hands	5	Other business	19
Managers	26	Employment not known	24
Textile designers and fabric experts	15	Married women	3
Purchasing agents	3	Not employed	2
In commission houses	6	Deceased	9
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Chemists, dyers and chemical salesmen	62	Total	341

Certified graduates of High Schools and Academies admitted without examination.

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Information as to the Courses of Study, Fees and Equipment is contained in the Illustrated Circular, which also includes a Partial List of Former Students together with the positions which they are filling in the Industry.

The Illustrated Circular, and advice as to suitable Courses of Study, may be had on application to the Director.

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BLEACHING KIERS
Allen Sons Co., Wm., Worcester, Mass.
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Dillon Steam Boiler Works, D. M., Fitchburg, Mass. *p. 154*
Jefferson, E. D. & Son, Boston, Mass.
New England Tank & Tower Co., Everett, Mass.
Philadelphia Drying Machinery Co., Philadelphia, Pa.
Philadelphia Textile Mach. Co., The, Philadelphia, Pa. *p. 137*
Textile-Finishing Machinery Co., The, Providence, R.I. *p. 136*
Worcester Steam Boiler Works, Worcester, Mass.

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BLEACHING MATERIALS
American Diamalt Co., New York, N.Y.
American Dyewood Co., New York, N.Y.
Andreykovicz & Dunk, Inc., Philadelphia, Pa.
Arnold, Hoffman & Co., Inc., Providence, R.I. *p. 145*
Bannon & Co., W. H., Providence, R.I.
Bosson & Lane, Atlantic, Mass. *p. 147*
Cone, Frederick H., New York, N.Y.
Electric Smelting & Alum Co., Lockport, N.Y.
Electro Bleaching Gas Co., New York, N.Y.
Ford Co., J. B., Wyandotte, Mich. *p. 146*
Malt Diastase Co., New York, N.Y.
Marden, Orth & Hastings Corp'n, New York, N.Y.
National Aniline & Chemical Co., Inc., New York, N.Y. *p. 142*
Niagara Alkali Co., Niagara Falls, N.Y.
Seydel Mfg. Co., The, Jersey City, N.J.
Southern Chemical Laboratory, Chattanooga, Tenn.
Wolf, Jaeques & Co., Passaic, N.J.
Worden Chemical Works, New York, N.Y.

BLOWERS
—Fan
American Blower Co., Detroit, Mich.
Buffalo Forge Co., Buffalo, N.Y. *p. 160*
Clarage Fan Co., Kalamazoo, Mich.
Coppus Engineering & Equip. Co., Worcester, Mass.
Garden City Fan Co., Chicago, Ill.
Green Fuel Economizer Co., New York, N.Y.
Ilg Electric Ventilating Co., Chicago, Ill.
New York Blower Co., Chicago, Ill.
Sterling Blower Co., Hartford, Conn.
Sturtevant Co., B. F., Boston, Mass. *pp. 158-9*

—Steam Jet
American Steam Conveyor Corp'n, Chicago, Ill.
Coe Co., C. T., Newark, N.J.
Eynon-Evans Mfg. Co., Philadelphia, Pa.
Green Engineering Co., E. Chicago, Ill.
Sauer Power Generating Co., Pittsburgh, Pa.
Schutte & Koerting Co., Philadelphia, Pa.

BOARDS, CUTTING
Tolhurst Machine Works, Troy, N.Y. *p. 139*

BOARDS, DRYING
Pearson, J. T., Kensington, Philadelphia, Pa.
Paramount Hos'y Form Dry'g Co., Chicago, Ill.
Phila. Drying Machinery Co., Philadelphia, Pa.

BOARDS, WINDING
Chaffee Bros. Co., Oxford, Mass. *p. 134*
Pearson, J. T., Kensington, Philadelphia, Pa.
Richardson Bros., New York, N.Y.

BOBBINS, SPOOLS, SHUTTLES, ETC.
Leigh & Butler, Boston, Mass. *p. 113*
New Bedford Shuttle Co., New Bedford, Mass.
Parker Spool & Bobbin Co., Lewiston, Me.
Shambow Shuttle Co., Woonsocket, R.I. *p. 120*
Tebbetts, E. L., Spool Co., Locke's Mill, Me.
U. S. Bobbin & Shuttle Co., Providence, R.I.
Vermont Spool & Bobbin Co., Burlington, Vt.
Williams, J. H., Co., Chicago, Ill.

BOILERS
—Internal Furnace
Bigelow Co., The, New Haven, Conn.
Casey-Hedges Co., Chattanooga, Tenn.
Dillon Steam Boiler Works, D. M., Fitchburg, Mass. *p. 154*
Erie City Iron Works, Erie, Pa.
International Engineering Works, Inc., Framingham, Mass. *p. 153*
Kingsford Foundry & Machine Works, Oswego, N.Y.
Mohr & Sons, John, Chicago, Ill.
Phoenix Iron Works, Meadville, Pa.
Springfield Boiler Co., Springfield, Ill.

—Return Tubular
Bigelow Co., New Haven, Conn.
Casey-Hedges Co., Chattanooga, Tenn.
Chandler & Taylor Co., Indianapolis, Ind.
Coatsville Boiler Works, New York, N.Y.
Cole Mfg. Co., R. D., Newnan, Ga.
Dillon Steam Boiler Works, D. M., Fitchburg, Mass. *p. 154*
Erie City Iron Works, Erie, Pa.
Hodge Boiler Works, East Boston, Mass.
Houston, Stanwood & Gamble Co., Cincinnati, O.
International Engineering Works, Inc., Framingham, Mass. *p. 153*
Lombard Iron Works & Supply Co., Augusta, Ga.
Phoenix Iron Works Co., Meadville, Pa.
Springfield Boiler & Mfg. Co., Springfield, Mass.
Stewart Boiler Works, Worcester, Mass.
Walsh & Weidner Boiler Co., The, Chattanooga, Tenn. *p. 155*
Ward Engineering Works, The Charles, Charleston, W.Va.
Wickes Boiler Co., The, Saginaw, Mich. *p. 152*

—Vertical Tubular
Bigelow Co., The, New Haven, Conn.
Casey-Hedges Co., Chattanooga, Tenn.
Cole Mfg. Co., R. D., Newnan, Ga.
Dillon Steam Boiler Works, D. M., Fitchburg, Mass. *p. 154*
Erie City Iron Works, Erie, Pa.
International Engineering Works, Inc., Framingham, Mass. *p. 153*
Phoenix Iron Works Co., Meadville, Pa.
Stewart Boiler Works, Worcester, Mass.
Wickes Boiler Co., The, Saginaw, Mich. *p. 152*

—Water Tube
Abendroth & Root Mfg. Co., New York, N.Y.
Babcock & Wilcox Co., New York, N.Y.
Badenhausen Co., Philadelphia, Pa.
Bass Foundry & Mach. Co., Fort Wayne, Ind.
Bigelow Co., New Haven, Conn.
Casey-Hedges Co., Chattanooga, Tenn.
Connelly Boiler Co., D., Cleveland, O.
Edge Moor Iron Co., Edge Moor, Del.
Erie City Iron Works, Erie, Pa.
Heine Safety Boiler Co., St. Louis, Mo.
International Engineering Works, Inc., Framingham, Mass. *p. 153*
Keeler Co., E., Williamsport, Pa.
Ladd Co., George T., Pittsburgh, Pa.
Mohr & Sons, John, Chicago, Ill.
Murray Iron Works Co., Burlington, Ia.
Page Boiler Co., Chicago, Ill.
Springfield Boiler Co., Springfield, Ill.
Union Iron Works, Erie, Pa.
Vogt Machine Co., Henry, Louisville, Ky.
Ward Engineering Works, The Charles, Charleston, W.Va.
Wickes Boiler Co., The, Saginaw, Mich. *p. 152.*

BOXES, BOX SHOOKS, ETC.
American Vulcanized Fibre Co., Boston, Mass.
Chaffee Bros. Co., Oxford, Mass. *p. 134*
Diamond State Fibre Co., Bridgeport, Pa.
Fibre Specialty Mfg. Co., Kennett Square, Pa.
Hinde & Dauch Paper Co., The, Philadelphia, Pa.
Rogers Fibre Co., Boston, Mass. *p. 141*
Pearson, J. T., Kensington, Philadelphia, Pa.
Standard Fibre Co., Somerville, Mass.

BRAIDING MACHINERY
Era Narrow Fabric Co., Providence, R.I.
Franklin Machine Co., Inc., Providence, R.I.
New England Butt Co., Providence, R.I
Reynolds, Jr., Wm., Providence, R.I.
Textile Machine Works, Reading, Pa.
Universal Winding Co., Providence, R.I. *p. 145*

BREAKERS
Woonsocket Machine & Press Co., Woonsocket, R.I. *p. 108*

BRICK
—Fire
American Enameled Brick & Tile Co., New York, N.Y.
Detrick Co., M. H., Chicago, Ill.
Didier-March Co., Perth Amboy, N.J.
Harbison-Walker Refractories Co., Pittsburgh, Pa.
Maurer & Son, Henry, New York, N.Y.
McLeod & Henry Co., Troy, N.Y.
Washburn & Granger, New York, N.Y.

BRUSHES
Curtis & Marble Machine Co., Worcester, Mass. *p. 114*
Hardy, Frank H., Andover, Mass.
Mason Brush Works, Worcester, Mass.
Parks & Woolson Machine Co., Springfield, Vt. *p. 115*

BRUSHING MACHINES
Butterworth, H. W. Sons & Co., Philadelphia, Pa. *p. 135*
Curtis & Marble Machine Co., Worcester, Mass. *p. 114*
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Jacobs Mfg. Co., E. H., Danielson, Conn. *p. 121*

BURNERS
—Oil
Anthony Co., Long Island City, N.Y.
Best, Inc., W. N., New York, N.Y.
De La Vergne Machine Co., New York, N.Y.
Gilbert & Barker Mfg. Co., Springfield, Mass.
Gwynn Gas Burner & Engineering Co., Pittsburgh, Pa.
Kenworthy, Charles F., Waterbury, Conn.
MacLeod Co., Cincinnati, O.
National Supply Co., Chicago, Ill.
Rockwell Co., W. S., New York, N.Y.
Spray Engineering Co., Boston, Mass.
Tate-Jones & Co., Inc., Pittsburgh, Pa.

CALENDERS
Butterworth & Sons Co., H. W., Philadelphia, Pa. *p. 135*

CALENDER ROLL GRINDERS
(See Grinding Machinery)

CALORIMETERS
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Emerson Apparatus Co., Boston, Mass.
Precision Instrument Co., Detroit, Mich.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

CANS, DYE HOUSE
Diamond State Fibre Co., Bridgeport, Pa.
Hill, James, Mfg. Co., Providence, R.I.
Standard Fibre Co., Somerville, Mass.

CANS, ROVING
American Vulcanized Fibre Co., Boston, Mass.
Cronkite Co., The, Boston, Mass.
Diamond State Fibre Co., Bridgeport, Pa.
Fibre Specialty Mfg. Co., Kennett Square, Pa.
Hill, James, Mfg. Co., Providence, R.I.
Rogers Fibre Co., Boston, Mass. *p. 141*
Standard Fibre Co., Somerville, Mass.

CARBONIZING MACHINERY
Phila. Drying Machinery Co., Philadelphia, Pa.
Phila. Textile Machinery Co., Philadelphia, Pa. *p. 137*
Sargent's Sons Corp., C. G., Graniteville, Mass.
Textile-Finishing Machinery Co., The, Providence, R.I. *p. 136*
Tolhurst Machine Works, Troy, N.Y. *p. 139*

CARD CLOTHING
American Card Clothing Co., Worcester, Mass.
Ashworth Bros., Fall River, Mass. *p. 126*
Atkinson, Haserick & Co., Boston, Mass.
Buhlmann, A. W., New York, N.Y.
Crabb, Wm. & Co., Newark, N.J.
Firth, Wm., Boston, Mass. *p. 112*
Howard Bros. Mfg. Co., Worcester, Mass. *p. 127*
Leigh & Butler, Boston, Mass. *p. 113*

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CARD MACHINERY
—Jacquard
Royle & Sons, John, Paterson, N.J. *p. 140*

CARDING MACHINERY
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Mason Machine Works, Taunton, Mass. *p. 107*
Saco-Lowell Shops, Boston, Mass. *p. 101*
Whitin Machine Works, Whitinsville, Mass. *p. 104*
Woonsocket Machine & Press Co., Woonsocket, R.I. *p. 108*

CARS
—Industrial Railway
Atlas Car & Mfg. Co., Cleveland, O.
Chase Foundry & Mfg. Co., Columbus, O.
Chattanooga Car & Foundry Co., Chattanooga, Tenn.
Eastern Car & Construction Co., Easton, Pa.
Hunt Co., Inc., C. W., West New Brighton, N.Y.
Link-Belt Co., Chicago, Ill.
Stuebner Iron Works, G. L., Long Island City, N.Y.
Youngstown Steel Car Co., Youngstown, O.

CEMENT
—Belt
Alexander Bros., Philadelphia, Pa.
Boston Belting Co., Boston, Mass.
Bradford Belting Co., Cincinnati, O.
Graton & Knight Manufacturing Co., The, Worcester, Mass. *p. 164*
Holyoke Belting Co., Holyoke, Mass.
Jewell Belting Co., Hartford, Conn.
Lawrence Belting Co., New York, N.Y.
Moloney Belting Co., Chicago, Ill.

CHAIN BELTS AND DRIVES
Abell-Howe Co., Chicago, Ill.
Link-Belt Company, Chicago, Ill.
Morse Chain Co., Ithaca, N.Y. *pp. 162-3*

CHEMICALS
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CHLORINE, LIQUID
Arnold, Hoffman & Co., Inc., Providence, R.I. *p. 145*

CIRCUIT BREAKERS
Condit Electrical Mfg. Co., South Boston, Mass.
General Electric Co., Schenectady, N.Y.
Roller-Smith Co., New York, N.Y.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. *p. 161*

CLUTCHES
—Friction
American Tool & Machine Co., Boston, Mass. *p. 178*
Brown Co., A. & F., New York, N.Y.
Caldwell & Son Co., H. W., Chicago, Ill.
Dodge Sales & Engineering Co., Mishawaka, Ind.
Falls Clutch & Machinery Co., Cuyahoga Falls, O.
Hill Clutch Co., Cleveland, O.
Johnson Machine Co., Carlyle, Manchester, Conn.
Jones Foundry & Machine Co., W. A., Chicago, Ill.
Link-Belt Co., Chicago, Ill.
Medart Patent Pulley Co., St. Louis, Mo.
Weller Mfg. Co., Chicago, Ill.
Wellman-Seaver-Morgan Co., Cleveland, O.
Wood's Sons Co., T. B., Chambersburg, Pa.

COAL AND ASH HANDLING MACHINERY
American Steam Conveyor Corp'n, Chicago, Ill.
Brown Portable Conveying Machinery Co., Chicago, Ill.
Caldwell & Son Co., H. W., Chicago, Ill.
Chain Belt Co., Milwaukee, Wis.
Hunt Co., Inc., C. W., West New Brighton, N.Y.
Industrial Workers, Bay City, Mich.
Jeffrey Mfg. Co., The, Columbus, O.
Lidgerwood Mfg. Co., New York, N.Y.
Link-Belt Co., Chicago, Ill.
Weller Mfg. Co., Chicago, Ill.

COILS, PIPE
Cox Engineering & Tube Bending Machine Works, Bayonne, N.J.
Crane Co., Chicago, Ill.
National Pipe Bending Co., The, New Haven, Conn. *p. 157*
Pipe Coiling, Bending & Welding Co., Pittsburgh, Pa.
Simmons Co., John, New York, N.Y.

COLORS
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COMBERS
Atkinson, Haserick & Co., Boston, Mass.
Entwistle Co., T. C., Lowell, Mass. *p. 111*
Hood Co., R. H., Philadelphia, Pa.
Jefferson, Edward, Philadelphia, Pa.
Leigh & Butler, Boston, Mass. *p. 113*
Loom Reed & Harness Co., The, Charlotte, N.C.
Whitin Machine Works, Whitinsville, Mass. *p. 104*

COMBUSTION (CO_2) RECORDERS
Combustion Appliances Co., Chicago, Ill.
Precision Instrument Co., Detroit, Mich.
Uehling Instrument Co., New York, N.Y.

COMPOUNDS
—Boiler
Binghamton Boiler Compound Co., Binghamton, N.Y.

Bird-Archer Co., New York, N.Y.
Dearborn Chemical Co., Chicago, Ill.
Engineering Supply Co., Philadelphia, Pa.
Harris Oil Co., A. W., Providence, R.I.
International Boiler Compound Co., Chicago, Ill.
North American Chemical & Engineering Co., New York, N.Y.
Paige & Jones Chemical Co., Inc., New York, N.Y.
Perolin Co. of America, Chicago, Ill.
Shawmut Chemical Co., Boston, Mass.

COMPRESSORS
—Air
American Steam Pump Co., Battle Creek, Mich.
Bury Compressor Co., Erie, Pa.
Chicago Pneumatic Tool Co., Chicago, Ill.
Hardie-Tynes Mfg. Co., Birmingham, Ala.
Hooven, Owens, Rentschler Co., Hamilton, O.
Ingersoll-Rand Co., New York, N.Y.
Nordberg Mfg. Co., Milwaukee, Wis.
Norwalk Iron Works Co., So. Norwalk, Conn.
Sullivan Machinery Co., Chicago, Ill.
Vilter Mfg. Co., Milwaukee, Wis.
Worthington Pump & Machinery Corp'n, New York, N.Y.

CONCRETE CONSTRUCTION
(See Contractors)

CONDENSERS
Alberger Pump & Condenser Co., New York, N.Y.
Baragwanath & Son, Wm., Chicago, Ill.
Blake Pump & Condenser Co., Fitchburg, Mass.
Davidson Co., M. T., New York, N.Y. *p. 156*
Dean Bros. Steam Pump Works, Indianapolis, Ind.
Epping-Carpenter Pump Co., Pittsburgh, Pa.
Schutte & Koerting Co., Philadelphia, Pa.
Wheeler Condenser & Engineering Co., Carteret, N.J.
Wheeler Mfg. Co., Philadelphia, Pa.
Wood & Co., R. D., Philadelphia, Pa.
Worthington Pump & Machinery Corp'n, New York, N.Y.

CONERS AND WINDERS
Foster Machine Co., Westfield, Mass. *p. 124*
Keystone Winding & Twisting Co., Philadelphia, Pa.
LeBon Bleach & Dye Works, Pawtucket, R.I.
Scientific Textile Co., Morrisville, Pa.
Textile Service Company, Philadelphia, Pa.

CONES AND TUBES, PAPER
Alpha Cone Co., Philadelphia, Pa.
Consolidated Paper Tube Co., Philadelphia, Pa.
National Paper Tube Co., Philadelphia, Pa.
Pairpoint Corporation, New Bedford, Mass.
Philadelphia Cone Co., Philadelphia, Pa.
Sinclair Cone Co., Norristown, Pa.
Universal Winding Co., Providence, R.I. *p. 125*

CONTRACTORS
—Building
Aberthaw Construction Co., Boston, Mass. *p. 175*
Austin Co., The, Cleveland, O.
Crowell-Lundoff-Little Co., The, Cleveland, O.
Ferguson Co., John W., Paterson, N.J. *p. 174*
Ferro Concrete Construction Co., Cincinnati, O. *p. 176*
Flynt Building Construction Co., Palmer, Mass.
Ford, Bacon & Davis, New York, N.Y.
Hennebique Construction Co., New York, N.Y.
Ley & Co., Inc., Fred T., Springfield, Mass.
Stone & Webster Engineering Corp., Boston, Mass.
Turner Construction Co., New York, N.Y.
White & Co., Inc., J. G., New York, N.Y.

CONTROLLERS
—Electric
Cutler-Hammer Mfg. Co., Milwaukee, Wis.
Electric Controller & Mfg. Co., Cleveland, O.
Fort Wayne Engineering & Mfg. Co., Fort Wayne, Ind.
General Electric Co., Schenectady, N.Y.
Industrial Controller Co., Milwaukee, Wis.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. *p. 161*

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CONVEYING MACHINERY
American Conveyor Co., Chicago, Ill.
Alvey Mfg. Co., St. Louis, Mo.
Barber-Greene Co., Aurora, Ill.
Caldwell & Son Co., H. W., Chicago, Ill.
Chain Belt Co., Milwaukee, Wis.
Gifford-Wood Co., Hudson, N.Y.
Hill Clutch Co., Cleveland, O.
Hunt Co., Inc., C. W., West New Brighton, N.Y.
Jones Foundry & Machine Co., Chicago, Ill.
Lamson Co., The, Boston, Mass.
Link-Belt Co., Chicago, Ill.
Mathews Gravity Carrier Co., Ellwood City, Pa.
Robins Conveying Belt Co., New York, N.Y.
Weller Mfg. Co., Chicago, Ill.
Willcox Engineering Co., Saginaw, Mich.

COOLING TOWERS (Natural and Forced Draft)
Cooling Tower Co., New York, N.Y.
Seymour, Jr., J. M., Newark, N.J.
Wheeler Condenser & Engineering Co., Carteret, N.J.
Worthington Pump & Machinery Corp'n, New York, N.Y.

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COPPER PRINTING ROLLERS
Taunton-New Bedford Copper Co., New Bedford, Mass.
Textile-Finishing Machinery Co., The, Providence, R.I. *p. 136*

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Butterworth, H. W. & Sons Co., Philadelphia, Pa. *p. 135*
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Ashworth Bros., Fall River, Mass. *p. 126*
Atkinson, Haserick & Co., Boston, Mass.
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Crompton & Knowles Loom Wks., Worcester, Mass. *p. 103*
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Easton & Burnham Machine Co., Pawtucket, R.I. *p. 110*
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Lever Co., Inc., Oswald, Philadelphia, Pa.
Leyland & Co., Thos., Readville, Mass.
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Metallic Drawing Roll Co., The, Indian Orchard, Mass.
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Smith & Furbush Machine Co., Philadelphia, Pa.
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—Revolution
Bristol Co., Waterbury, Conn.
Brown Instrument Co., Philadelphia, Pa.
Durant Mfg. Co., Milwaukee, Wis.
Lonergan Co., J. E., Philadelphia, Pa.
Root & Co., C. J., Bristol, Conn.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Veeder Mfg. Co., Hartford, Conn.

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Dodge Sales & Engineering Co., Mishawaka, Ind.
Hill Clutch Co., Cleveland, O.
Jones Foundry & Machine Co., W. A., Chicago, Ill.
Weller Mfg. Co., Chicago, Ill.
Wood's Sons Co., T. B., Chambersburg, Pa.

COUNTING MACHINES
Durant Manufacturing Co., Milwaukee, Wis.
National Scale Co., Chicopee Falls, Mass.
Root, C. J. & Co., Bristol, Conn.
Veeder Mfg. Co., Hartford, Conn.

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Bond Co., Charles, Philadelphia, Pa.
Brown Co., A. & F., New York, N.Y.
Caldwell & Son Co., H. W., Chicago, Ill.
Chain Belt Co., Milwaukee, Wis.
Dodge Sales & Engineering Co., Mishawaka, Ind.
Falls Clutch & Machinery Co., Cuyahoga Falls, O.
Hill Clutch Co., Cleveland, O.
Jones Foundry & Machine Co., W. A., Chicago, Ill.
Link-Belt Co., Chicago, Ill.
Medart Patent Pulley Co., St. Louis, Mo.
Royersford Foundry & Machine Co., Philadelphia, Pa.
Weller Mfg. Co., Chicago, Ill.
Wood's Sons Co., T. B., Chambersburg, Pa.

COVERINGS
—Steam Pipe
American District Steam Co., No. Tonawanda, N.Y.
Carey Co., Philip, Cincinnati, O.
Ehret Magnesia Mfg. Co., Valley Forge, Pa.
Fibre Cell Asbestos Mfg. Co., Chicago, Ill.
Franklin Mfg. Co., Franklin, Pa.
Johns-Manville Co., H. W., New York, N.Y.
Keasbey Co., Robert A., Ambler, Pa.
Magnesia Association of America, Philadelphia, Pa.
National Air Cell Covering Co., Jersey City, N.J.
Nightingale & Childs Co., Boston, Mass.
Standard Asbestos Mfg. Co., Chicago, Ill.
Wyckoff & Son Co., A., Elmira, N.Y.

CRAYONS
American Crayon Co., Waltham, Mass.
Binney & Smith Co., New York, N.Y.
Dixon Crucible Co., Jos., Jersey City, N.J.
Howe Mill Crayon Co., Lowell, Mass.
Lowell Crayon Co., Lowell, Mass.

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Cameron Machine Co., Brooklyn, N.Y.
Eastman Machine Co., Buffalo, N.Y.
Grand Rapids Tex. Machy. Co., Grand Rapids, Mich.
Ireland Mach. & Fdry. Co., Norwich, N.Y.
Metropolitan Sewing Mach. Co., Nyack, N.Y.

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Tanner & Co., Charles, Providence, R.I.

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New York Blower Co., Chicago, Ill.
Philadelphia Drying Machinery Co., Philadelphia, Pa.
Philadelphia Textile Machinery Co., Philadelphia, Pa. *p. 137*
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du Pont de Nemours & Co., E. I., Wilmington, Del. *p. 143*

DYEING, DRYING, BLEACHING AND FINISHING MACHINERY
American Laundry Machinery Co., Cincinnati, O.

American Tool & Machine Co., Boston, Mass. *p. 178*
Frank Bailey, Camden, N.J.
Buffalo Forge Co., Buffalo, N.Y. *p. 160*
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Electro Chemical Co., Dayton, O.
Elliott & Hall, Worcester, Mass.
Franklin Process Co., Providence, R.I.
Hunt Machine Co., Rodney, Orange, Mass.
Hussong Dyeing Machine Co., Groveville, N.J.
Kenyon & Son, D. R., Raritan, N.J.
Klauder-Weldon Dyeing Mach. Co., Yardley, Pa.
Leigh & Butler, Boston, Mass. *p. 113*
Paramount Hos'y Form Dry'g Co., Chicago, Ill.
Parks & Woolson Machine Co., Springfield, Vt. *p. 115*
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Phila. Drying Machinery Co., Philadelphia, Pa.
Phila. Textile Machinery Co., Philadelphia, Pa. *p. 137*
Reliance Machine Works, Philadelphia, Pa.
Roy & Son Co., B. S., Worcester, Mass. *p. 130*
Salem Iron Works, Winston-Salem, N.C.
Sargent's Sons Corp., C. G., Graniteville, Mass.
Smith, Drum & Co., Philadelphia, Pa.
Sturtevant Co., B. F., Boston, Mass. *pp. 158–9*
Suter, Alfred, New York, N.Y.
Tait, G. W., Providence, R.I.
Textile-Finishing Machinery Co., The, Providence, R.I. *p. 136*
Tolhurst Machine Works, Troy, N.Y. *p. 139*

DYE KETTLES

Allen Sons Co., Wm., Worcester, Mass.
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DYE STICKS

Bailey, Frank, Cedar Brook, N.J.
Klauder-Weldon Dyeing Machine Co., Yardley, Pa.
Philadelphia Drying Machinery Co., Philadelphia, Pa.

DYESTUFFS AND CHEMICALS

Adelphia Dye & Chemical Co., Philadelphia, Pa.
American Aniline Products, Inc., New York, N.Y.
American Dyewood Co., Boston, Mass.
Arabol Mfg. Co., New York, N.Y.
Arnold, Hoffman & Co., Inc., Providence, R.I. *p. 145*
Bayer Co., Inc., The, New York, N.Y.
Bosson & Lane, Atlantic, Mass. *p. 147*
Cassella Color Co., New York, N.Y.
Chemical Co. of America, Inc., New York, N.Y.
Cronkite Co., The Leonard W., Boston, Mass.
du Pont de Nemours & Co., E. I., Wilmington, Del. *p. 143*
Gibson, F. Swift, Philadelphia, Pa.
Klipstein & Co., A., New York, N.Y.
National Oil Products Co., Harrison, N.J.
Roessler & Hasslacher Chemical Co., New York, N.Y.
Saxe Chemical Co., New York, N.Y.
Sterling Color Co., Inc., New York, N.Y.
Wolf & Co., Jacques, Passaic, N.J.

ECONOMIZERS, FUEL

Green Fuel Economizer Co., New York, N.Y.
Sturtevant Co., B. F., Boston, Mass., *pp. 158–9*

EJECTORS

American Injector Co., Detroit, Mich.
Hancock Inspirator Co., New York, N.Y.
Hayden & Derby Mfg. Co., New York, N.Y.
Penberthy Injector Co., Detroit, Mich.

ELEVATORS

—Passenger and Freight

Albro-Clem Elevator Co., Philadelphia, Pa.
American Elevator & Machine Co., Louisville, Ky.
Gurney Elevator Co., New York, N.Y.
McLauthlin Co., Geo. T., Boston, Mass.
Mason Co., Inc., Volney W., Providence, R.I.
Moore & Wyman Elevator & Machine Works, Boston, Mass.
Otis Elevator Co., New York, N.Y.
Ridgway & Son Co., Craig, Coatesville, Pa.
Standard Electric & Elev. Co., Baltimore, Md.
Standard Plunger Elevator Co., Worcester, Mass.
Wetherill & Co., Inc., Robt., Chester, Pa.
Wheeler-McDowell Elevator Co., New York.

—Portable

Economy Engineering Co., Chicago, Ill.
N. Y. Revolving Portable Elevator Co., Jersey City, N.J.

ENGINEERS

—Consulting

(See also Engineers, Industrial)
Archer and Associates, W. G., New York, N.Y.
Cary, Albert A., New York, N.Y.
Emerson Company, New York, N.Y.
Estes, Incorporated, L. V., Chicago, Ill.
Fish, Charles H., Boston, Mass.
Fletcher-Thompson, Inc., Bridgeport, Conn.
French & Hubbard, Boston, Mass.
Green Co., Samuel M., Springfield, Mass.
Hooper-Falkenau Engineering Co., New York, N.Y.
Jackson, D. C. & Wm. B., Boston, Mass.
Little, Inc., Arthur D., Boston, Mass.
Main, Charles T., Boston, Mass. *p. 174*
Meyer, Jr., Henry C., New York, N.Y.
Moore, Frederick C., Cleveland, O.
Sanderson & Porter, New York, N.Y.
Suter, Alfred, New York, N.Y.
Thompson & Lichtner, Boston, Mass.
Westinghouse Church Kerr & Co., New York, N.Y.
Woodwell, J. E., New York, N.Y.

ENGINEERS

—Industrial

Allen & Co., A. M., Cleveland, O.
Arnold Company, The, New York, N.Y.
Chase, Frank D., Chicago, Ill.
Baker, Sutton & Harrison, New York, N.Y.
Day & Zimmenson, Philadelphia, Pa.
Dean, Inc., Francis W., Boston, Mass.
DeWolf & Co., John O., Boston, Mass.
Dyer, W. E. S., Philadelphia, Pa.
Fletcher, Thompson, Inc., Bridgeport, Conn.
Ford, Bacon & Davis, New York, N.Y.
French & Hubbard, Boston, Mass.
Gardner & Lindberg, Chicago, Ill.
Gray, Arthur F., Boston, Mass.
Green Company, Samuel M., Springfield, Mass.
Hooper-Falkenau Engineering Co., New York, N.Y.
Kimball, Herbert S., Boston, Mass.
Knoeppel & Co., C. E., New York, N.Y.
Lockwood Greene & Co., Boston, Mass. *p. 173*
Main, Charles T., Boston, Mass. *p. 174*
Marvell, Edward I., Fall River, Mass.
Makepeace, C. R., Providence, R.I.
Monks & Johnson, Boston, Mass.
Peuckert & Wunder, Philadelphia, Pa.
Prather, H. B., Cleveland, O.
Scofield Engineering Company, Philadelphia, Pa.
Seabury, Dwight, Pawtucket, R.I.
Sellers, Philip, New Haven, Conn.
Sheldon Co., F. P., Providence, R.I.

Sirrine, J. E., Greenville, S.C.
Stevens, John A., Lowell, Mass.
Stone & Webster Engineering Corp., Boston, Mass.
Suek, Adolph, Hyde Park, Mass.
Watson Engineering Co., Cleveland, O.
Westinghouse Church Kerr Co., New York, N.Y.
White & Co., Inc., J. C., New York, N.Y.
Woodmansee-Davidson Engrg. Co., Chicago, Ill.

ENGINES
—Steam
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Ball Engine Co., Erie, Pa.
Bass Foundry & Machine Co., Fort Wayne, Ind.
Brown Engine Co., Fitchburg, Mass.
Erie City Iron Works, Erie, Pa.
Fitchburg Steam Engine Co., Fitchburg, Mass.
Fulton Iron Works Co., St. Louis, Mo.
Hardie-Tynes Mfg. Co., Birmingham, Ala.
Harrisburg Foundry & Machine Works, Harrisburg, Pa.
Harris-Corliss Engine & Machine Co., Providence, R.I.
Hewes & Phillips Iron Works, Newark, N.J.
Hooven, Owens, Rentschler Co., Hamilton, O.
Houston, Stanwood & Gamble Co., Cincinnati, O.
Ide & Sons, A. L., Springfield, Ill.
Lane & Bodley Co., Cincinnati, O.
Mesta Machine Co., Pittsburgh, Pa.
Murray Iron Works Co., Burlington, Ia.
Nordberg Mfg. Co., Milwaukee, Wis.
Providence Engineering Corp'n, Providence, R.I.
Reeves-Cubberly Engine Co., Trenton, N.J.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Rollins Engine Co., Nashua, N.H.
Skinner Engine Co., Erie, Pa.
Sturtevant Co., B. F., Boston, Mass. *pp. 158–9*
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. *p. 161*
Wetherill & Co., Inc., Robt., Chester, Pa.

EXHAUST HEADS
Burt Mfg. Co., Akron, O.
Direct Separator Co., Syracuse, N.Y.
Hoppes Mfg. Co., The, Springfield, O.
Ohio Blower Co., Cleveland, O.
Patterson & Co., Frank L., New York, N.Y.
Pittsburgh Valve, Foundry & Const. Co., Pittsburgh, Pa.
Sturtevant Co., B. F., Boston, Mass. *pp. 158–9*

EXPANDERS, CLOTH
Leyland, Thos. & Co., Readville, Mass.

EXPANSION JOINTS
Alberger Pump & Condenser Co., New York, N.Y.
Badger & Sons, E. B., Boston, Mass. *p. 168*
Tyler Underground Heating System, Pittsburgh, Pa.

EXTRACTORS, HYDRO-
(See Hydro-Extractors)

EXTRACTS
(See Dyestuffs & Chemicals)

FANS, EXHAUST
American Blower Co., Detroit, Mich.
Barney Ventilating Fan Works, Boston, Mass.
Buffalo Forge Co., Buffalo, N.Y. *p. 160*
Dixie Mfg. Co., Inc., Baltimore, Md.
Garden City Fan Co., Chicago, Ill.
Green Fuel Economizer Co., New York, N.Y.
Howard & Morse, New York, N.Y.
Indiana Fan Co., Indianapolis, Ind.
National Blow Pipe & Mfg. Co., Ltd., New Orleans, La.
Perkins & Son, B. F., Holyoke, Mass.
Philadelphia Drying Machinery Co., Philadelphia, Pa.
Sterling Blower Co., Hartford, Conn.
Sturtevant Co., B. F., Boston, Mass. *pp. 158–9*
Tolhurst Machine Works, Troy, N.Y. *p. 139*

FEEDS, AUTOMATIC
Curtis & Marble Mach. Co., Worcester, Mass. *p. 114*
Phila. Drying Machinery Co., Philadelphia, Pa.
Phila. Textile Machinery Co., Philadelphia, Pa. *p. 137*
Saco-Lowell Shops, Boston, Mass. *p. 101*
Sargent's Sons Corp., C. G., Graniteville, Mass.
Schofield, Wm., Co., Manayunk, Philadelphia, Pa.
Smith & Furbush Machine Co., Philadelphia, Pa.
Tatham, William, Ltd., Rochdale, England (Wm. Firth, Agent)
Woonsocket Mach. & Press Co., Woonsocket, R.I. *p. 108*

FENCES, WIRE (IRON)
Anchor Post Iron Works, New York, N.Y.
Cyclone Fence Co., Waukegan, Ill.
Enterprise Iron Works, Indianapolis, Ind.
Page Steel & Wire Co., Adrian, Mich.
Stewart Iron Works Co., Covington, Ky.
Wright Wire Co., Worcester, Mass.

FILTERS
—Water
American Water Softener Co., Philadelphia, Pa.
Beggs & Co., James, New York, N.Y.
Casey-Hedges Co., Chattanooga, Tenn.
Harrison Safety Boiler Works, Philadelphia, Pa.
Hungerford & Terry, Inc., Philadelphia, Pa. *p. 172*
Hygeia Filter Co., Detroit, Mich.
International Filter Co., Chicago, Ill.
Leigh & Butler, Boston, Mass. *p. 113*
Loomis-Manning Filter Distributing Co., Philadelphia, Pa.
New York Continental Jewell Filtration Co., New York, N.Y.
Permutit Co., New York, N.Y.
Pittsburgh Filter Mfg. Co., Pittsburgh, Pa.
Roberts Filter Mfg. Co., Darby, Pa.
Scaife & Sons Co., Wm. B., Pittsburgh, Pa.

FINISHING MACHINERY
(See also Dyeing, Drying, Bleaching and Finishing)
Butterworth & Sons Co., H. W., Philadelphia, Pa. *p. 135*
Philadelphia Drying Machinery Co., Philadelphia, Pa.
Philadelphia Textile Machinery Co., Philadelphia, Pa. *p. 137*
Textile-Finishing Machinery Co., The, Providence, R.I. *p. 136*

FIRE DOOR FIXTURES (Automatic)
Automatic Sprinkler Co. of America, New York, N.Y.
Coburn Trolley Track Mfg. Co., Holyoke, Mass.
Richards-Wilcox Mfg. Co., Aurora, Ill.
Stowell Co., So. Milwaukee, Wis.

FIRE EXTINGUISHERS
American-La France Fire Engine Co., Inc., Elmira, N.Y.
Automatic Sprinkler Co. of America, New York, N.Y.
Johns-Manville Co., H. W., New York, N.Y.
Montgomery & Co., Inc., New York, N.Y.

FLYERS
Bodden, Wm., & Son, Ltd., Providence, R.I.
Firth, William, Boston, Mass. *p. 112*
H. & B. American Machine Co., Pawtucket, R.I. *p. 106*
Southern Spindle & Flyer Co., Charlotte, N.C. *p. 119*

FOLDING MACHINERY
Curtis & Marble Machine Co., Worcester, Mass. *p. 114*

FRAMES, UNIVERSAL
Steel Heddle Mfg. Co., Philadelphia, Pa. *p. 118*

FUEL ECONOMIZERS
(See Economizers, Fuel)

FUSES
D & W Fuse Co., Providence, R.I.
Detroit Fuse & Mfg. Co., Detroit, Mich.
Economy Fuse & Mfg. Co., Chicago, Ill.
General Electric Co., Schenectady, N.Y.
Johns-Manville Co., H. W., New York, N.Y.
Johns-Pratt Co., Hartford, Conn.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. *p. 161*

FUSTIC
Kuttroff, Pickhardt & Co., Inc., New York, N.Y. *p. 144*

GARNET GRINDERS
(See Grinding Machinery)

GASKETS
(See Packing)

GASSING MACHINES
(See Singeing Machines)

GAUGE GLASSES
Ashton Valve Co., Cambridge, Mass.
Chesterton Co., A. W., Boston, Mass.
Crane Co., Chicago, Ill.
Durabla Mfg. Co., New York, N.Y.
Magee Valve Co., Inc., New York, N.Y.

GAUGES
—Pressure
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Ashcroft Mfg. Co., New York, N.Y.
Ashton Valve Co., Cambridge, Mass.
Baeharach Industrial Instrument Co., Pittsburgh, Pa.
Bristol Co., Waterbury, Conn.
Brown Instrument Co., Philadelphia, Pa.
Crosby Steam Gage & Valve Co., Boston, Mass.
Foxboro Co., Foxboro, Mass.
Lonergan Co., J. E., Philadelphia, Pa.
Pittsburgh Gage & Supply Co., Pittsburgh, Pa.
Precision Instrument Co., Detroit, Mich.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Star Brass Mfg. Co., Boston, Mass.
Tagliabue Mfg. Co., C. J., Brooklyn, N.Y.
Uehling Instrument Co., New York, N.Y.
United States Gauge Co., New York, N.Y.

GENERATING SETS
American Blower Co., Detroit, Mich.
General Electric Co., Schenectady, N.Y.
Sturtevant Co., B. F., Boston, Mass. *pp. 158–9*
Terry Steam Turbine Co., Hartford, Conn.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. *p. 161*

GENERATORS
—Electric
C & C Electric & Mfg. Co., Garwood, N.J.
Crocker-Wheeler Co., Ampere, N.J.
De Laval Steam Turbine Co., Trenton, N.J.
Emerson Electric Mfg. Co., St. Louis, Mo.
General Electric Co., Schenectady, N.Y.
Reliance Electric & Eng. Co., Cleveland, O.
Robbins & Myers Co., Springfield, O.
Sprague Electric Works, New York, N.Y.
Sturtevant Co., B. F., Boston, Mass. *pp. 158–9*
Western Electric Co., Inc., New York, N.Y.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. *p. 161*

GIGS
Curtis & Marble Machine Co., Worcester, Mass. *p. 114*
Hunt Machine Co., Rodney, Orange, Mass.
Parks & Woolson Machine Co., Springfield, Vt. *p. 115*

GOVERNORS
—Engine and Pump
Fisher Governor Co., Marshalltown, Ia.
Ford Co., Thomas P., New York, N.Y.
Foster Engineering Co., Newark, N.J.
Gardner Governor Co., Quincy, Ill.
Houston, Stanwood & Gamble Co., Cincinnati, O.
Ideal Automatic Governor Co., Newark, N.J.
Northern Equipment Co., Erie, Pa.
Pickering Governor Co., Portland, Conn.
Richardson-Phenix Co., Milwaukee, Wis.
Waters Governor Co., Lawrence, Mass.

GRATES
—Shaking
Bass Foundry & Machine Co., Fort Wayne, Ind.
Casey-Hedges Co., Chattanooga, Tenn.
Dillon Steam Boiler Works, D. M., Fitchburg, Mass. *p. 154*
International Engineering Works, Inc., Framingham, Mass. *p. 153*
Keeler Co., E., Williamsport, Pa.
McClave-Brooks Co., Scranton, Pa.
Marshall Foundry Co., Pittsburgh, Pa.
Martin Grate Co., Chicago, Ill.
New England Roller Grate Co., Springfield, Mass.
Shelvin Engineering Co., Inc., New York, N.Y.
Springfield Boiler Co., Springfield, Ill.
Wickes Boiler Co., The, Saginaw, Mich. *p. 152*

GREASE
Albany Lubricating Co., New York, N.Y.
Houghton & Co., E. F., Philadelphia, Pa.
Keystone Lubricating Co., Philadelphia, Pa.
New York & New Jersey Lubricant Co., New York, N.Y. *p. 170*
Philadelphia Grease Mfg. Co., Philadelphia, Pa.
Standard Oil Co. of New York, New York, N.Y.
Swan & Finch, New York, N.Y. *p. 171*
Texas Co., New York, N.Y.
Valvoline Oil Co., New York, N.Y.
Wolverine Lubricants Co. of N.Y., New York, N.Y.

GREASES
—Textile
Borne Scrymser Co., New York, N.Y.
Brierly-Lombard Co., The, Worcester, Mass.
Jackson & Co., Ellis, Philadelphia, Pa.

GRINDING MACHINERY, CARD
Atkinson, Haserick & Co., Boston, Mass.
Entwistle, T. C., Co., Lowell, Mass. *p. 111*
Firth, Wm., Boston, Mass. *p. 112*
Hubbard Machine Co., Worcester, Mass.
Leigh & Butler, Boston, Mass. *p. 113*
Roy & Son Co., B. S., Worcester, Mass. *p. 130*
Smith & Furbush Machine Co., Philadelphia, Pa.

GUIDERS, CLOTH
Butterworth & Sons Co., H. W., Philadelphia, Pa. *p. 135*
Leyland, Thos. & Co., Readville, Mass.
Textile-Finishing Machinery Co., The, Providence, R.I. *p. 136*

GUMS
(See Sizing, Starch and Gums)

HANGERS
—Shaft
Bond Co., Charles, Philadelphia, Pa.
Brown Co., A. & F., New York, N.Y.
Chain Belt Co., Milwaukee, Wis.
Dodge Sales & Engineering Co., Mishawaka, Ind.
Falls Clutch & Machinery Co., Cuyahoga Falls, O.
Hill Clutch Co., Cleveland, O.
Link-Belt Co., Chicago, Ill.
Medart Patent Pulley Co., St. Louis, Mo.
Royersford Foundry & Machine Co., Philadelphia, Pa.
Weller Mfg. Co., Chicago, Ill.

HARNESSES
Crompton & Knowles Loom Wks., Worcester, Mass. *p. 105*
Emmons Loom Harness Co., Lawrence, Mass.
Garland Mfg. Co., Saco, Me.

Loom Reed & Harness Co., Charlotte, N.C.
Moore, C., & Co., Philadelphia, Pa.
Steele Heddle Mfg. Co., Philadelphia, Pa. *p. 118*

HEATERS
—Feed Water
Alberger Heater Co., Buffalo, N.Y.
Baragwanath & Son, Wm., Chicago, Ill.
Houston, Stanwood & Gamble Co., Cincinnati, O.
Keeler Co., E., Williamsport, Pa.
National Pipe Bending Co., The, New Haven, Conn. *p. 157*
Stewart Heater Co., Buffalo, N.Y.
Walsh & Weidner Boiler Co., The, Chattanooga, Tenn. *p. 155*
Whitlock Coil Pipe Co., Hartford, Conn.
Worthington Pump & Machinery Corp'n, New York, N.Y.

HEATERS AND PURIFIERS
—Feed Water
Elliott Co., Pittsburgh, Pa.
Harrison Safety Boiler Works, Philadelphia, Pa.
Hoppes Mfg. Co., Springfield, O.
National Pipe Bending Co., The, New Haven, Conn. *p. 157*
Platt Iron Works, Dayton, O.
Stewart Heater Co., Buffalo, N.Y.
Webster & Co., Warren, Camden, N.J.

HEATING SYSTEMS
—Vacuum
Consolidated Engineering Co., Chicago, Ill.
Dunham Co., C. A., Chicago, Ill.
Illinois Engineering Co., Chicago, Ill.
Keeler Co., E., Williamsport, Pa.
Webster & Co., Warren, Camden, N.J.

HEATING AND VENTILATING APPARATUS
American Blower Co., Detroit, Mich.
American District Steam Co., N. Tonawanda, N.Y.
American Radiator Co., Chicago, Ill.
Buffalo Forge Co., Buffalo, N.Y. *p. 160*
Carrier Engineering Corp., New York, N.Y. *p. 149*
Consolidated Engineering Co., Chicago, Ill.
Cramer, Stuart W., Charlotte, N.C. *p. 151*
Smith Co., H. B., Westfield, Mass.
Sturtevant Co., B. F., Boston, Mass. *pp. 158–9*
Webster & Co., Warren, Camden, N.J.

HEDDLES AND FRAMES
Atkinson, Haserick & Co., Boston, Mass.
Firth, William, Boston, Mass. *p. 112*
Garland Mfg. Co., Saco, Me.
Gowdey Reed & Harness Mfg. Co., J. A., Providence, R.I.
Loom Reed & Harness Co., Charlotte, N.C.
Steel Heddle Mfg. Co., Philadelphia, Pa. *p. 118*
Walker Mfg. Co., Philadelphia, Pa.
Williams, J. H. Co., Chicago, Ill.

HOBBING MACHINES
Barber-Colman Co., Rockford, Ill. *p. 129*

HOBS
Barber-Colman Co., Rockford, Ill. *p. 129*

HOSE
—Rubber
Boston Belting Co., Boston, Mass.
Boston Woven Hose & Rubber Co., Cambridge, Mass.
Goodrich Co., B. F., Akron, O.
Goodyear Tire & Rubber Co., Akron, O.
Gutta Percha & Rubber Mfg. Co., New York, N.Y.
Johns-Manville Co., H. W., New York, N.Y
New York Belting & Packing Co., New York, N.Y.
New York Rubber Co., New York, N.Y.
Quaker City Rubber Co., Philadelphia, Pa.
Revere Rubber Co., Chelsea, Mass.

HUMIDIFIERS
American Blower Co., Detroit, Mich.
American Moistening Co., Boston, Mass. *p. 148*
Braemer Air Conditioning Corp'n, Philadelphia, Pa.
Carrier Air Conditioning Co., Buffalo, N.Y.
Carrier Engineering Corp'n, New York, N.Y. *p. 149*
Cramer, Stuart W., Charlotte, N.C. *p. 151*
Normalair Co., Winston-Salem, N.C.
Parks Co., G. M., Fitchburg, Mass. *p. 150*
Tillotson Humidifier Co., Providence, R.I.

HYDRANTS, FIRE
Darling Pump & Mfg. Co., Ltd., Williamsport, Pa.
Eddy Valve Co., Waterford, N.Y.
Kennedy Valve Mfg. Co., Elmira, N.Y.
Ludlow Valve Mfg. Co., Troy, N.Y.
Norwood Engineering Co., Florence, Mass.
Pratt & Cady Co., Inc., Hartford, Conn.
Wood & Co., R. D., Philadelphia, Pa.
Worthington Pump & Machinery Corp'n, New York, N.Y.

HYDRO-EXTRACTORS
American Tool & Machine Co., Boston, Mass. *p. 178*
Atkinson, Haserick & Co., Boston, Mass.
Buhlmann, A. W., New York, N.Y.
Hunt Machine Co., Rodney, Orange, Mass.
Street and Co., R. R., Chicago, Ill.
Textile-Finishing Machinery Co., The, Providence, R.I. *p. 136*
Tolhurst Machine Works, Troy, N.Y. *p. 139*

INDICATORS
—Engine
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Crosby Steam Gage & Valve Co., Boston, Mass.
Powell Co., The Wm., Cincinnati, O.
Robertson & Sons, James L., New York, N.Y.
Thompson & Co., Richard, New York, N.Y.
Trill Indicator Co., Corry, Pa.

INDIGO
Cronkhite Co., The Leonard W., Boston, Mass.
Klipstein & Co., A., New York, N.Y.
Kuttroff, Pickhardt & Co., New York, N.Y. *p. 144*
Zobel Company, Inc., Ernst, Brooklyn, N.Y.

INJECTORS
American Injector Co., Detroit, Mich.
Crane Co., Chicago, Ill.
Hancock Inspirator Co., New York, N.Y.
Jenkins Bros., New York, N.Y.
Nathan Mfg. Co., Flushing, N.Y.
Penberthy Injector Co., Detroit, Mich.

INSTRUMENTS
—Electrical Measuring
Biddle, James G., Philadelphia, Pa.
Brown Instrument Co., Philadelphia, Pa.
General Electric Co., Schenectady, N.Y.
Jewell Electrical Instrument Co., Chicago, Ill.
Leeds & Northrup Co., Philadelphia, Pa.
Pyroleetric Instrument Cos., Trenton, N.J.
Robert Instrument Co., Detroit, Mich.
Taylor Instrument Cos., Rochester, N.Y.
Thompson-Levering Co., Philadelphia, Pa.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. *p. 161*
Weston Electrical Instrument Co., Newark, N.J.

INSULATING MATERIALS
—Heat and Cold
Armstrong Cork & Insulation Co., Pittsburgh, Pa.
Booth Felt Co., Inc., Brooklyn, N.Y.
Celite Products Co., New York, N.Y.
Ehret Magnesia Mfg. Co., Valley Forge, Pa.
Fibre Cell Asbestos Mfg. Co., Chicago, Ill.
Johns-Manville Co., H. W., New York, N.Y.
Keasbey & Mattison Co., Ambler, Pa.

Magnesia Association of America, Philadelphia, Pa.
Nightingale & Childs Co., Boston, Mass.
Standard Asbestos Mfg. Co., Chicago, Ill.
United States Mineral Wool Co., New York, N.Y.

INSURANCE, LIABILITY
American Mutual Liability Insurance Co., Boston, Mass. *p. 140*

INTERMEDIATES
Chemical Co. of America, Inc., New York, N.Y.
du Pont de Nemours & Co., E. I., Wilmington, Del. *p. 143*

JACQUARDS
Crompton & Knowles Loom Wks., Worcester, Mass. *p. 103*
Halton's, Thomas, Sons, Philadelphia, Pa.

KETTLES, STEAM JACKET
Butterworth, H. W. & Sons Co., Philadelphia, Pa. *p. 135*
Duriron Castings Co., New York, N.Y.
Textile-Finishing Machinery Co., The, Providence, R.I. *p. 136*

KIERS
(See Bleaching Kiers)

KNITTING MACHINES
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—Metal
Berger Mfg. Co., Canton, O.
Durand Steel Locker Co., Chicago, Ill.
Edwards Mfg. Co., Cincinnati, O.
Lupton's Sons Co., David, Philadelphia, Pa.
Manufacturing Equip. & Mfg. Co., Framingham, Mass.
Narragansett Machine Co., Providence, R.I.
Wright Wire Co., Worcester, Mass.

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Albany Lubricating Co., New York, N.Y.
Indian Refining Co., Inc., New York, N.Y.
Kellogg & Co., E. H., New York, N.Y.
Keystone Lubricating Co., Philadelphia, Pa.
McCord Mfg. Co., Inc., Detroit, Mich.
New York & New Jersey Lubricant Co., New York, N.Y. *p. 170*
Philadelphia Grease Mfg. Co., Philadelphia, Pa.
Richardson-Phenix Co., The, Milwaukee, Wis.
Robinson & Son Co., Wm. C., Baltimore, Md.
Standard Oil Co., Chicago, Ill.
Swan & Finch Co., New York, N.Y. *p. 171*
Texas Co., New York, N.Y.
Vacuum Oil Co., New York, N.Y.
White & Bagley Co., Worcester, Mass.

LUBRICATORS
—Force-Feed
Detroit Lubricator Co., Detroit, Mich.
Greene, Tweed & Co., New York, N.Y.
Inter-State Machine Products Co., Rochester, N.Y.
McCord Mfg. Co., Detroit, Mich.
Madison-Kipp Lubricator Co., Madison, Wis.
Richardson-Phenix Co., Milwaukee, Wis.

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Root & Co., C. J., Bristol, Conn.
Smith, Wm. & Sons, Lawrence, Mass.
Street & Co., R. R., Chicago, Ill.
Windle, J. E., Worcester, Mass.

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Jefferson, Edward, Philadelphia, Pa.
Klauder-Weldon Dyeing Machine Co., Yardley, Pa.
Smith, Drum & Co., Philadelphia, Pa.
Standard Processing Co., Philadelphia, Pa.
Textile-Finishing Machinery Co., The, Providence, R.I. *p. 136*

METERS
—Steam
American District Steam Co., No. Tonawanda, N.Y.
Bailey Meter Co., Boston, Mass.
Builders Iron Foundry, Providence, R.I.
General Electric Co., Schenectady, N.Y.
New Jersey Meter Co., Plainfield, N.J.
Republic Flow Meters Co., Chicago, Ill.
Sargent Steam Meter Co., Chicago, Ill.

—Water
Bailey Meter Co., Boston, Mass.
Buffalo Meter Co., Buffalo, N.Y.
General Electric Co., Schenectady, N.Y.
Harrison Safety Boiler Works, Philadelphia, Pa.
Hersey Mfg. Co., South Boston, Mass.
National Meter Co., New York, N.Y.
Neptune Meter Co., New York, N.Y.
Precision Instrument Co., Detroit, Mich.
Simmons Co., John, New York, N.Y.
Union Water Meter Co., Worcester, Mass.
Willcox Engineering Co., Saginaw, Mich.
Worthington Pump & Machinery Corp'n, New York, N.Y.
Yarnall-Waring Co., Philadelphia, Pa.

MILLING CUTTERS
Barber-Colman Co., Rockford, Ill. *p. 129*

MOTORS
—Electric
Burke Electric Co., Erie, Pa.
C & C Electric & Mfg. Co., Garwood, N.J.
Crocker-Wheeler Co., Ampere, N.J.
Diehl Mfg. Co., Elizabethport, N.J.
Electro-Dynamic Co., Bayonne, N.J.
Emerson Electric Mfg. Co., St. Louis, Mo.
General Electric Co., Schenectady, N.Y.
Kimble Electric Co., Chicago, Ill.
Peerless Electric Co., Warren, O.
Robbins & Myers Co., Springfield, O.
Roth Bros. & Co., Chicago, Ill.
Sturtevant Co., B. F., Boston, Mass. *pp. 158–9*
Triumph Electric Co., The, Cincinnati, O.
Wagner Electric Mfg. Co., St. Louis, Mo.
Western Electric Co., Inc., New York, N.Y.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. *p. 161*

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Leigh & Butler, Boston, Mass. *p. 113*
Parks & Woolson Machine Co., Springfield, Vt. *p. 115*
Schwartz, L. H. A. & Co.

OIL BURNING EQUIPMENT
Anthony Co., Long Island City, N.Y.
Best, Inc., W. N., New York, N.Y.
Gilbert & Barker Mfg. Co., Springfield, Mass.
Gwynn Gas Burner & Engineering Co., Pittsburgh, Pa.
Hammel Oil Burning Equipment Co., Providence, R.I.
Ideal Automatic Governor Co., Newark, N.J.
Lockett & Co., A. M., New Orleans, La.
Mietz Corporation, August, New York, N.Y.
National Supply Co., Chicago, Ill.
Production Engineering Co., Philadelphia, Pa.
Rockwell Co., W. S., New York, N. Y.
Tate-Jones & Co., Inc., Pittsburgh, Pa.

OIL SEPARATING MACHINES (Centrifugal)
American Tool & Machine Co., Boston, Mass. *p. 178*
De Laval Steam Turbine Co., Trenton, N.J.
D'Olier Centrifugal Pump & Machine Co., Philadelphia, Pa.
National Separator & Machine Co., Boston, Mass.
Oil & Waste Saving Machine Co., Philadelphia, Pa.
Tolhurst Machine Works, Troy, N.Y. *p 139*

OIL STORAGE SYSTEMS
Bowser & Co., Inc., S. F., Fort Wayne, Ind.
Gilbert & Barker Mfg. Co., Springfield, Mass.
Richardson-Phenix Co., Milwaukee, Wis.
Wayne Oil Tank & Pump Co., Fort Wayne, Ind.

OILS
—Lubricating
Albany Lubricating Co., New York, N.Y.
Eagle Oil & Supply Co., Boston, Mass.
Houghton & Co., E. F., Philadelphia, Pa.
Indian Refining Co., New York, N.Y.
New York & New Jersey Lubricant Co., New York, N.Y. *p. 170*
Petroleum Refining Co., Houston, Tex.
Standard Oil Co. of New York, New York, N.Y.
Swan & Finch Co., New York, N.Y. *p. 171*
Texas Co., New York, N.Y.
Vacuum Oil Co., New York, N.Y.
Valvoline Oil Co., New York, N.Y.
White & Bagley Co., Worcester, Mass.

—Textile
Arnold, Hoffman & Co., Inc., Providence, R.I. *p. 145*
Atlantic Refining Co., Philadelphia, Pa.
Borne, Scrymser Company, New York, N.Y.
Bosson & Lane, Atlantic, Mass. *p. 147*
Cone & Co., Frederick H., New York, N.Y.
Cooper & Cooper, New York, N.Y.
Crew, Levick Co., Philadelphia, Pa.
Drew & Co., Inc., E. F., Boston, Mass.
Dunker & Perkins, Boston, Mass.
Fancourt & Co., Inc., W. F., Philadelphia, Pa.
Garnet Co., The, Allentown, Pa.
Harding, Inc., H. C., Philadelphia, Pa.
Jackson & Co., Ellis, Philadelphia, Pa.
Jordan, Inc., W. H. & F., Jr., Philadelphia, Pa.
Kuttroff, Pickhardt & Inc., New York, N.Y. *p. 144*
Leyland & Co., Thos., Readville, Mass.
Marden, Orth & Hastings, Boston, Mass.
Miller Mfg. Co., Providence, R.I.
National Oil Products Co., Harrison, N.J.
N.Y. & N.J. Lubricant Co., New York, N.Y. *p. 170*
Rub-No-More Co., Fort Wayne, Ind.
Seydel Mfg. Co., Jersey City, N.J.
Swan & Finch Co., New York, N.Y. *p. 171*
Ulco Oil Co., Detroit, Mich.
Wolf & Co., Jacques, Passaic, N.J.
Zurn Co., O. F., Philadelphia, Pa.

OPENERS
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Firth, Wm., Boston, Mass. *p. 112*
H. & B. American Machine Co., Pawtucket, R.I. *p. 106*
Jefferson, Edward, Philadelphia, Pa.
Leigh & Butler, Boston, Mass. *p. 113*
Saco-Lowell Shops, Boston, Mass. *p. 101*
Whitin Machine Works, Whitinsville, Mass. *p. 104*
Woonsocket Mach. & Press Co., Woonsocket, R.I. *p. 108*

OXIDIZING MACHINERY
Delahunty Dyeing Machine Co., Pittston, Pa. *p. 138*

PACKAGING MACHINERY
Curtis & Marble Machine Co., Worcester, Mass. *p. 114*
Parks & Woolson Machine Co., Springfield, Vt. *p. 115*

PACKING
—Asbestos
Asbestos & Rubber Works of America, New York, N.Y.
Crane Co., Chicago, Ill.
Federal Asbestos Co., Paterson, N.J.
Franklin Mfg. Co., Franklin, Pa.
Johns-Manville Co., H. W., New York, N.Y.
Johns-Pratt Co., Hartford, Conn.
Keasbey Co., Robert A., New York, N.Y.
Keasbey & Mattison Co., Ambler, Pa.
McCord Mfg. Co., Inc., Detroit, Mich.
New Jersey Asbestos Co., Camden, N.J.
—Sheet
American Vulcanized Fibre Co., Wilmington, Del.

Boston Belting Co., Boston, Mass.
Cancos Mfg. Co., Philadelphia, Pa.
Endura Mfg. Co., Philadelphia, Pa.
Garlock Packing Co., Palmyra, N.Y.
Goetze Gasket & Packing Co., New Brunswick, N.J.
Goodrich Co., B. F., Akron, O.
Hamilton Rubber Mfg. Co., Trenton, N.J.
Jenkins Bros., New York, N.Y.
Johns-Manville Co., H. W., New York, N.Y.
New York Belting & Packing Co., New York, N.Y.
New York Rubber Co., New York, N.Y.
Quaker City Rubber Co., Philadelphia, Pa.

PACKING LEATHER
Graton & Knight Mfg. Co., The, Worcester Mass. *p. 164*

PAINTS AND VARNISHES
Arco Company, Cleveland, O.
Chaffee Co., Thos. K., Providence, R.I. *p. 134*
Chicago White Lead & Oil Co., Chicago, Ill.
Dixon Crucible Co., Jos., Jersey City, N.J.
Hampden Paint & Chemical Co., Springfield, Mass.
Harrison Works, Wilmington, Del. *p. 177*
Lowe Bros. Co., The, Dayton, O.
Patton Paint Co., Milwaukee, Wis.
Toch Brothers, New York, N.Y.
U. S. Gutta Percha Paint Co., Providence, R.I.
U. S. Varnish Co., New York, N.Y.
Wadsworth, Howland Co., Boston, Mass.

PAPER AND TWINE
Blauvelt-Wiley Paper Mfg. Co., New York, N.Y.
Consolidated Paper Tube Co., Philadelphia, Pa.
Greene Paper Co., R. L., Providence, R.I. *p. 141*
Kelley Co., Henry C., New York, N.Y.
Lane, Albert A., New York, N.Y.
Merwin Paper Co., The, Hartford, Conn.
O'Meara Co., Maurice, New York, N.Y.
Richardson Bros., New York, N.Y.

PICKERS, BURR
Curtis & Marble Machine Co., Worcester, Mass. *p. 114*
Sargent's Sons Corp., C. G., Graniteville, Mass.
Smith & Furbush Machine Co., Philadelphia, Pa.

PICKERS, LEATHER
Foulds & Sons, Inc., Hudson, Mass.
Garland Mfg. Co., Saco, Me.
Graton & Knight Mfg. Co., The, Worcester, Mass. *p. 164*
Jacob Mfg. Co., E. H., Danielson, Conn. *p. 121*

PICKERS, RAG
Curtis & Marble Mach. Co., Worcester, Mass. *p. 114*
Dodge, C. S., Lowell, Mass.
Schofield, Wm., Co., Manayunk, Philadelphia, Pa.
Smith & Furbush Machine Co., Philadelphia, Pa.
Tatham, William, Ltd., Rochdale, England (Wm. Firth, Agent) *p. 112*

PICKING MACHINERY
H. & B. American Machine Co., Pawtucket, R.I. *p. 106*
Saco-Lowell Shops, Boston, Mass. *p. 101*
Whitin Machine Works, Whitinsville, Mass. *p. 104*
Woonsocket Machine & Press Co., Woonsocket, R.I. *p. 108*

POWER TRANSMISSION MACHINERY
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Tool & Machine Co., Boston, Mass. *p. 178*
Birmingham Iron Foundry, Derby, Conn.
Caldwell & Son Co., H. W., Chicago, Ill.
Chain Belt Co., Milwaukee, Wis.
Cresson-Morris Co., Philadelphia, Pa.
Dodge Sales & Engineering Co., Mishawaka, Ind.
Falls Clutch & Machinery Co., Cuyahoga Falls, O.
Hill Clutch Co., Cleveland, O.
Hunt Machine Co., Rodney, Orange, Mass.
Link-Belt Co., Chicago, Ill.
Lombard Iron Works & Supply Co., Augusta, Ga.
Morse Chain Co., Ithaca, N.Y. *pp. 162–3*
Poole Engineering & Machine Co., Baltimore, Md.
Royersford Foundry & Machine Co., Philadelphia, Pa.
Weller Mfg. Co., Chicago, Ill.
Wood's Sons Co., T. B., Chambersburg, Pa.

PREPARATORY MACHINERY
Jefferson, Edward, Philadelphia, Pa.
Leigh & Butler, Boston, Mass. *p. 113*
Saco-Lowell Shops, Boston, Mass. *p. 101*
Smith & Furbush Machine Co., Philadelphia, Pa.

PRESSES
Alsteel Manufacturing Co., Battle Creek, Mich.
American Laundry Machinery Co., Cincinnati, O.
Boomer & Boschert Press Co., Syracuse, N.Y.
Buhlmann, A. W., New York, N.Y.
Butterworth, H. W. & Sons Co., Philadelphia, Pa. *p. 135*
Curtis & Marble Machine Co., Worcester, Mass. *p. 114*
Dodge, C. S., Lowell, Mass.
Lorimer, John H., Philadelphia, Pa.
Phila. Drying Machinery Co., Philadelphia, Pa.
Reliance Machine Works, Philadelphia, Pa.
Saco-Lowell Shops, Boston, Mass. *p. 101*
Smith & Furbush Mach. Co., Philadelphia, Pa.
Spence & Rideout, Nashua, N.H.
Textile-Finishing Machinery Co., The, Providence, R.I. *p. 136*
U. S. Hoffman Co., Syracuse, N.Y.

PRESSES (Baling)
Economy Baler Co., Ann Arbor, Mich.
Garrett & Co., Sylvester S., Philadelphia, Pa.
Klein Co., H. J., Louisville, Ky.
Sullivan Machinery Co., Chicago, Ill.

PRESS BOARDS AND PAPERS
Diamond State Fibre Co., Bridgeport, Pa.
Greene Paper Co., R. L., Providence, R.I. *p. 141*
Merwin Paper Co., Hartford, Conn.
Phila. Drying Machinery Co., Philadelphia, Pa.

PROSPECTING MACHINERY
Curtis & Marble Machine Co., Worcester, Mass. *p. 114*
Parks & Woolson Machine Co., Springfield, Vt. *p. 115*

PULLEYS
—Iron
American Tool & Machine Co., Boston, Mass. *p. 178*
Brown Co., A. & F., New York, N.Y.
Caldwell & Son Co., H. W., Chicago, Ill.
Chain Belt Co., Milwaukee, Wis.
Cork Insert Co., Boston, Mass.
Dodge Sales & Engineering Co., Cuyahoga Falls, O.
Falls Clutch & Machinery Co., Cuyahoga Falls, O.
Hill Clutch Co., Cleveland, O.
Hunt Machine Co., Rodney, Orange, Mass.
Link-Belt Co., Chicago, Ill.
Medart Patent Pulley Co., St. Louis, Mo.
Poole Engineering & Machine Co., Baltimore, Md.
Standard Pulley Co., Cincinnati, O.
Weller Mfg. Co., Chicago, Ill.
Wood's Sons Co., T. C., Chambersburg, Pa.

—Wood
Caldwell & Son Co., H. W., Chicago, Ill.
Detroit Pulley Co., Detroit, Mich.
Dodge Sales & Engineering Co., Mishawaka, Ind.
Eclipse Wood Pulley Co., Inc., Berlin, Pa.
Jones Foundry & Machine Co., W. A., Chicago, Ill.

Menasha Wood Split Pulley Co., Menasha, Wis.
Reading Wood Pulley Co., Reading, Pa.
Reeves Pulley Co., Columbus, Ind.
Weller Mfg. Co., Chicago, Ill.

PUMPS
—Boiler Feed
American Steam Pump Co., Battle Creek, Mich.
Cameron Steam Pump Works, A. S., New York, N.Y.
Davidson Co., M. T., New York, N.Y. *p. 156*
Deming Co., Salem, O.
Douglas, W. & B., Middletown, Conn.
Epping-Carpenter Pump Co., Pittsburgh, Pa.
Hall Steam Pump Co., Pittsburgh, Pa.
International Steam Pump Co., New York, N.Y.
Morris Machine Works, Baldwinsville, N.Y.
Platt Iron Works, Dayton, O.
Reilly Mfg. Co., J. J., Louisville, Ky.
Worthington Pump & Machinery Corp'n, New York, N.Y.

—Centrifugal
Advance Pump & Compressor Co., Battle Creek, Mich.
Alberger Pump & Condenser Co., New York, N.Y.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Steam Pump Co., Battle Creek, Mich.
American Well Works, Aurora, Ill.
Bagley & Sewall Co., Watertown, N.Y.
Buffalo Steam Pump Co., Buffalo, N.Y.
Cameron Steam Pump Works, A. S., New York, N.Y.
Dayton Turbine Pump Co., Cleveland, O.
De Laval Steam Turbine Co., Trenton, N.J.
D'Olier Centrifugal Pump & Machine Co., Philadelphia, Pa.
Epping-Carpenter Pump Co., Pittsburgh, Pa.
Goulds Mfg. Co., Seneca Falls, N.Y.
Kingsford Foundry & Machine Works, Oswego, N.Y.
Lawrence Pump & Engine Co., Lawrence, Mass.
Morris Co., I. P., Philadelphia, Pa.
Pelton Water Wheel Co., San Francisco, Cal.
Platt Iron Works, Dayton, O.
Rumsey Pump Co., Ltd., Seneca Falls, N.Y.
United Steam Pump Co., Battle Creek, Mich.
Wilson-Snyder Mfg. Co., Pittsburgh, Pa.
Wood & Co., R. D., Philadelphia, Pa.
Worthington Pump & Machinery Corp'n, New York, N.Y.

—Fire
Cameron Steam Pump Works, A. S., New York, N.Y.
De Laval Steam Turbine Co., Trenton, N.J.
Deming Co., Salem, O.
Fales & Jenks Machine Co., Pawtucket, R.I. *p. 109*
Morris Machine Works, Baldwinsville, N.Y.
Platt Machine Works, Dayton, O.

—Power
Advance Pump & Compressor Co., Battle Creek, Mich.
American Steam Pump Co., Battle Creek, Mich.
Buffalo Steam Pump Co., Buffalo, N.Y.
Cameron Steam Pump Works, A. S., New York, N.Y.
Dayton Pump & Mfg. Co., Dayton, O.
Dean Bros. Steam Pump Works, Indianapolis, Ind.
Deming Co., Salem, O.
Epping-Carpenter Pump Co., Pittsburgh, Pa.
Gardner Governor Co., Quincy, Ill.
Luitwieler Pumping Engine Co., Rochester, N.Y.
Morris Machine Works, Baldwinsville, N.Y.
Novo Engine Co., Lansing, Mich.
Platt Iron Works, Dayton, Mich.
Worthington Pump & Machinery Corp'n, New York, N.Y.

PYROMETERS
—Electric
Bristol Co., Waterbury, Conn.
Brown Instrument Co., Philadelphia, Pa.
Combustion Appliances Co., Chicago, Ill.
Eimer & Amend, New York, N.Y.
Foxboro Co., Foxboro, Mass.
Leeds & Northrup Co., Philadelphia, Pa.
Tagliabue Mfg. Co., C. J., Brooklyn, N.Y.
Taylor Instrument Co's., Rochester, N.Y.
Thwing Instrument Co., Philadelphia, Pa.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. *p. 161*

QUILLERS
Foster Machine Co., Westfield, Mass. *p. 124*
Payne, G. W. & Co., Pawtucket, R.I.
Terrell Machine Co., Charlotte, N.C.
Universal Winding Co., Boston, Mass. *p. 125*

REEDS, LOOM
American Supply Co., Providence, R.I.
Emmons Loom Harness Co., Lawrence, Mass.
Knowles Loom Reed Works, New Bedford, Mass.
Schmidt & Co., H. E., New Bedford, Mass.
Steel Heddle Mfg. Co., Philadelphia, Pa. *p. 118*
Whitaker Reed Co., The, Worcester, Mass.

REELS
Draper Corporation, Hopedale, Mass. *p. 102*
Easton & Burnham Machine Co., Pawtucket, R.I. *p. 110*
Whitin Machine Works, Whitinsville, Mass. *p. 104*

REGULATORS
—Damper
American District Steam Co., North Tonawanda, N.Y.
D'Este Co., Julian, Boston, Mass.
Ford Co., Thomas P., New York, N.Y.
Locke Regulator Co., Salem, Mass.
Standard Regulator Co., Newark, N.J.
Watts Regulator Co., Lawrence, Mass.

—Feed Water
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Boston Steam Specialty Co., Boston, Mass.
Foster Engineering Co., Newark, N.J.
Jarvis Engineering Co., Boston, Mass.
Northern Equipment Co., Erie, Pa.
Sorge, Jr. & Co., A., Chicago, Ill.
Tagliabue Mfg. Co., C. J., Brooklyn, N.Y.

—Pressure
American District Steam Co., No. Tonawanda, N.Y.
Brown Instrument Co., Philadelphia, Pa.
Crane Co., Chicago, Ill.
Davis Regulator Co., G. M., Chicago, Ill.
Ford Co., Thomas P., New York, N.Y.
Foster Engineering Co., Newark, N.J.
Ideal Automatic Governor Co., Newark, N.J.
Leslie Co., Lyndhurst, N.J.
Mason Regulator Co., Boston, Mass.
Mueller Mfg. Co., H., Decatur, Ill.
National Regulator Co., New York, N.Y.
Tagliabue Mfg. Co., C. J., Brooklyn, N.Y.
Watts Regulator Co., Lawrence, Mass.

RINGS, SPINNING
Draper Corporation, Hopedale, Mass. *p. 102*
H. & B. American Machine Co., Pawtucket, R.I. *p. 106*
Southern Spindle & Flyer Co., Charlotte, N.C. *p. 119*
Whitinsville Spinning Ring Co., Whitinsville, Mass. *p. 122*

RINGS, TWISTER
Whitinsville Spinning Ring Co., Whitinsville, Mass. *p. 122*

ROLLING MACHINERY
Curtis & Marble Machine Co., Worcester, Mass. *p. 114*
Parks & Woolson Machine Co., Springfield, Vt. *p. 115*

ROLLS, CALENDER
Butterworth & Sons Co., H. W., Philadelphia, Pa. *p. 135*

Perkins & Son, Inc., B. F., Holyoke, Mass.
Textile-Finishing Machinery Co., The, Providence, R.I. *p. 136*

ROLLS, FLUTED
Firth, William, Boston, Mass. *p. 112*
H. & B. American Machine Co., Pawtucket, R.I. *p. 106*
Metallic Drawing Roll Co., Indian Orchard, Mass.

ROOFING MATERIALS
Barber Asphalt Paving Co., Philadelphia, Pa.
Barrett Co., The, New York, N.Y.
Certain-teed Products Corp., New York, N.Y.
Penn Metal Co., Boston, Mass.

ROPE
—Transmission
American Mfg. Co., Brooklyn, N.Y.
Columbian Rope Co., Auburn, N.Y.
Dodge Sales & Engineering Co., Mishawaka, Ind.
Hunt Co., Inc., C. W., West New Brighton, N.Y.
Lambeth Rope Corp'n, New Bedford, Mass.
Macomber & Whyte Rope Co., Kenosha, Wis.
Plymouth Cordage Co., North Plymouth, Mass.
St. Louis Cordage Mills, St. Louis, Mo.
Waterbury Co., New York, N.Y.

ROVING MACHINERY
H. & B. American Machine Co., Pawtucket, R.I. *p. 106*
Saco-Lowell Shops, Boston, Mass. *p. 101*
Whitin Machine Works, Whitinsville, Mass. *p. 104*
Woonsocket Machine & Press Co., Woonsocket, R.I. *p. 108*

SASH OPERATING DEVICES
Detroit Steel Products Co., Detroit, Mich.
Drouve Co., G., Bridgeport, Conn.
Hitchings & Co., Elizabeth, N.J.
Lupton's Sons Co., David, Philadelphia, Pa.

SCALES
—Automatic
American Kron Scale Co., New York, N.Y. *p. 169*
Conveying Weigher Co., New York, N.Y.
Howe Scale Co. of N. Y., New York, N.Y.
National Scale Co., Chicopee Falls, Mass.
Richardson Scale Co., Passaic, N.J.
Simmons Co., John, New York, N.Y.
Toledo Scale Co., Toledo, O.

—Conveyer
Electric Weighing Co., New York, N.Y.
Link-Belt Co., Chicago, Ill.

—Dormant
American Kron Scale Co., New York, N.Y. *p. 169*
Buffalo Scale Co., Buffalo, N.Y.
Fairbanks Co., New York, N.Y.
Jones of Binghamton, Inc., Binghamton, N.Y.
Standard Scale & Supply Co., Pittsburgh, Pa.
Toledo Scale Co., Toledo, O.

—Platform
American Kron Scale Co., New York, N.Y. *p. 169*
Buffalo Scale Co., Buffalo, N.Y.
Chatillon & Sons, John, New York, N.Y.
Fairbanks Co., New York, N.Y.
Howe Scale Co. of N. Y., New York, N.Y.
Toledo Scale Co., Toledo, O.

SCHOOLS
—Textile
Bradford Durfee Textile School, Fall River, Mass. *p. 181*
Lowell Textile School, Lowell, Mass. *p. 179*
New Bedford Textile School, New Bedford, Mass. *p. 183*
Philadelphia Textile School, Philadelphia, Pa. *p. 180*
Rhode Island School of Design, Providence, R.I. *p. 182*

SCREENS
See Wire, Woven)

SEPARATORS
—Oil
Austin Separator Co., Detroit, Mich.
Baragwanath & Son, Wm., Chicago, Ill.
Boston Steam Specialty Co., Boston, Mass.
Crane Co., Chicago, Ill.
Direct Separator Co., Syracuse, N.Y.
Harrison Safety Boiler Works, Philadelphia, Pa.
National Pipe Bending Co., The, New Haven, Conn. *p. 157*
Pittsburgh Valve, Foundry & Const. Co., Pittsburgh, Pa.
Standard Steam Specialty Co., New York, N.Y.
Webster & Co., Warren, Camden, N.J.

—Steam
Anderson Co., V. D. W., Cleveland, O.
Austin Separator Co., Detroit, Mich.
Crane Co., Chicago, Ill.
D'Este Co., Julian, Boston, Mass.
Direct Separator Co., Syracuse, N.Y.
Hardie-Tynes Mfg. Co., Birmingham, Ala.
Harrison Safety Boiler Works, Philadelphia, Pa.
Hoppes Mfg. Co., Springfield, O.
National Pipe Bending Co., The, New Haven, Conn. *p. 157*
Ohio Blower Co., Cleveland, O.
Pittsburgh Valve, Foundry & Const. Co., Pittsburgh, Pa.
Webster & Co., Warren, Camden, N.J.

SEWING MACHINES
Dinsmore Mfg. Co., The, Salem, Mass. *p. 133*

SHAFTING
American Tool & Machine Co., Boston, Mass. *p. 178*
Brown Co., A. & F., New York, N.Y.
Caldwell & Son Co., H. W., Chicago, Ill.
Columbia Steel & Shafting Co., Pittsburgh, Pa.
Dodge Sales & Engineering Co., Mishawaka, Ind.
Falls Clutch & Machinery Co., Cuyahoga Falls, O.
Hill Clutch Co., Cleveland, O.
Link-Belt Co., Chicago, Ill.
Wood's Sons Co., T. B., Chambersburg, Pa.

SHEAVES
—Rope
American Pulley Co., Philadelphia, Pa.
Bass Foundry & Machine Co., Fort Wayne, Ind.
Caldwell & Son Co., H. W., Chicago, Ill.
Dodge Sales & Engineering Co., Mishawaka, Ind.
Falls Clutch & Machinery Co., Cuyahoga Falls, O.
Hardie-Tynes Mfg. Co., Birmingham, Ala.
Link-Belt Co., Chicago, Ill.
Weller Mfg. Co., Chicago, Ill.
Wellman-Seaver-Morgan Co., Cleveland, O.

SHELVING
—Metal
Berger Mfg. Co., Cleveland, O.
Bernstein Mfg. Co., Philadelphia, Pa.
Edwards Mfg. Co., Cincinnati, O.
Lupton's Sons Co., David, Philadelphia, Pa.
Manufacturing Equip. & Supply Co., Framingham, Mass.

SHUTTLES
(See also Bobbins, Spools, Shuttles, etc.)
Shambow Shuttle Co., Woonsocket, R.I. *p. 120*
Leigh & Butler, Boston, Mass. *p. 113*

SINGEING MACHINES
Butterworth, H. W., Sons Co., Philadelphia, Pa. *p. 135*
Curtis & Marble Machine Co., Worcester, Mass *p. 114*
Foster Machine Co., Westfield, Mass. *p. 124*
Hessa, Theodore F., New York, N.Y.
Kump Mfg. Co., C. M., Baltimore, Md.
Phila. Drying Machinery Co., Philadelphia, Pa.
Smith, Drum & Co., Philadelphia, Pa.
Textile-Finishing Machinery Co., The, Providence, R.I. *p. 136*

SIZING, STARCH AND GUMS
American Diamalt Co., New York, N.Y.
Arnold, Hoffman & Co., Inc., Providence, R.I. *p. 145*
Bosson & Lane, Atlantic, Mass. *p. 147*
Corn Products Refining Co., New York, N.Y.
Leyland, Thos., Co., Readville, Mass.
Malt-Diastase Co., New York, N.Y.
Morningstar, Chas. & Co., Inc., New York, N.Y.
Seydel Mfg. Co., The, Jersey City, N.J.
Sizing Specialties Co., Jersey City, N.J.
Stein, Hall & Co., New York, N.Y.
Wolf, Jacques & Co., Passaic, N.J.
Worden Chemical Works, New York, N.Y.

SLASHERS AND EQUIPMENT
H. & B. American Machine Co., Pawtucket, R.I. *p. 106*
Saco-Lowell Shops, Boston, Mass. *p. 101*
Textile-Finishing Machinery Co., The, Providence, R.I. *p. 136*
Warp Compressing Machine Co., Worcester, Mass. *p. 116*

SLUBBERS
Woonsocket Machine & Press Co., Woonsocket, R.I. *p. 108*

SOAPS
Arnold, Hoffman & Co., Inc., Providence, R.I. *p. 145*
Bosson & Lane, Atlantic, Mass. *p. 147*
Cronkite Co., The Leonard W., Boston, Mass.
Dobbins Soap Mfg. Co., Philadelphia, Pa.
Draper, J. O., Co., Pawtucket, R.I.
Dunker & Perkins, Boston, Mass.
Electric Smelt. & Alum. Co., Lockport, N.Y.
Fancourt & Co., W. F., Philadelphia, Pa.
Harding, Inc., H. C., Philadelphia, Pa.
Kenney Mfg. Co., F., Boston, Mass.
Rome Soap Co., Rome, N.Y.
Seydel Mfg. Co., The, Jersey City, N.J.
Standard Soap Mfg. Co., Woonsocket, R.I.
Warren Soap Mfg. Co., Boston, Mass.

SODA
Arnold, Hoffman & Co., Inc., Providence, R.I. *p. 145*
Ford Co., The J. B., Wyandotte, Mich. *p. 146*

SOFTENERS
Arnold, Hoffman & Co., Inc., Providence, R.I. *p. 145*
Bosson & Lane, Atlantic, Mass. *p. 147*
Harding & Fancourt, Inc., Philadelphia, Pa.
Holbrook Mfg. Co., Jersey City, N.J.
Houghton & Co., E. F., Philadelphia, Pa.
Jackson & Co., Ellis, Philadelphia, Pa.
Leyland & Co., Thos., Readville, Mass.
Marston, John P., Boston, Mass.
McMeekan Mfg. Co., David, Brooklyn, N.Y.
Quaker City Chemical Co., Philadelphia, Pa.
Seydel Mfg. Co., The, Jersey City, N.J.
Southern Chemical Laboratory, Chattanooga, Tenn.
Tanner Co., Chas. S., Providence, R.I.
Wolf & Co., Jacques, Passaic, N.J.
Zurn Co., O. F., Philadelphia, Pa.

SPEEDERS
H. & B. American Machine Co., Pawtucket, R.I. *p. 106*

SPINDLES
Atkinson, Haserick & Co., Boston, Mass.
Bamford & Smith, Providence, R.I.
Bodden, Wm. & Sons, Ltd., Providence, R.I.
Buckley's Sons, Benjamin, Paterson, N.J.
Chapman Mfg. Co., Boston, Mass. *p. 117*
Draper Corporation, Hopedale, Mass. *p. 102*
Easton & Burnham Machine Co., Pawtucket, R.I. *p. 110*
Fales & Jenks Machine Co., Pawtucket, R.I. *p. 109*
H. & B. American Machine Co., Pawtucket, R.I. *p. 106*
Saco-Lowell Shops, Boston, Mass. *p. 101*
Southern Spindle & Flyer Co., Charlotte, N.C. *p. 119*
Textile Supply Co., Pawtucket, R.I.

SPINNING FRAMES
Fales & Jenks Machine Co., Pawtucket, R.I. *p. 109*
H. & B. American Machine Co., Pawtucket, R.I. *p. 106*
Mason Machine Works, Taunton, Mass. *p. 107*
Saco-Lowell Shops, Boston, Mass. *p. 101*
Whitin Machine Works, Whitinsville, Mass. *p. 104*
Woonsocket Machine & Press Co., Woonsocket, R.I. *p. 108*

SPINNING TRAVELERS
(See Travelers, Ring)

SPOOLERS
Allen, A. W., Philadelphia, Pa.
Draper Corporation, Hopedale, Mass. *p. 102*
Easton & Burnham Machine Co., Pawtucket, R.I. *p. 110*
Lindsay, Hyde & Co., Philadelphia, Pa.
Payne, George W. & Co., Pawtucket, R.I.
Saco-Lowell Shops, Boston, Mass. *p. 101*
Smith & Furbush Machine Co., Philadelphia, Pa.
Spindler, E. O., New York, N.Y.
Warp Compressing Machine Co., Worcester, Mass. *p. 116*
Whitin Machine Works, Whitinsville, Mass. *p. 104*

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SPREADING MACHINERY
Curtis & Marble Machine Co., Worcester, Mass. *p. 114*

SPRINKLER SYSTEMS
Automatic Sprinkler Co. of America, New York, N.Y.
General Fire Extinguisher Co., Providence, R.I.
Globe Automatic Sprinkler Co., Philadelphia, Pa.
Rockwood Sprinkler Co. of Mass., Worcester, Mass.

SPROCKET WHEELS for Valve Operation
Babbitt Steam Specialty Co., New Bedford, Mass. *p. 147*

STACKS
Bigelow Co., The, New Haven, Conn.
Dillon Steam Boiler Works, D. M., Fitchburg, Mass. *p. 154*
International Engineering Works, Inc., Framingham, Mass. *p. 153*
Walsh & Weidner Boiler Co., The, Chattanooga, Tenn. *p. 155*
Wickes Boiler Co., The, Saginaw, Mich. *p. 152*

STARCHES
Arnold, Hoffman & Co., Inc., Providence, R.I. *p. 145*

STOKERS
American Engineering Co., Philadelphia, Pa.
Casey-Hedges Co., Chattanooga, Tenn.
Combustion Engineering Corp'n, New York, N.Y.
Coxe Traveling Grate Co., Hazleton, Pa.
Detroit Stoker Co., Detroit, Mich.
Greene Engineering Co., East Chicago, Ill.
Illinois Stoker Co., Alton, Ill.
Keystone Stoker Co., Greenfield, Mass.
Laclede-Christy Clay Products Co., St. Louis, Mo.
Lehigh Stoker Co., Fullerton, Pa.
Murphy Iron Works, Detroit, Mich.
Riley Stoker Co., Ltd., Sanford, Worcester, Mass.
Underfeed Stoker Co. of America, Chicago, Ill.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. *p. 161*

STRAPS, LUG
Garland Mfg. Co., Saco, Me.
Graton & Knight Mfg. Co., The, Worcester, Mass. *p. 164*
Jacobs Mfg. Co., E. H., Danielson, Conn. *p. 121*

STRIPPERS, CARD
Wm. Firth, Boston, Mass. *p. 112*

SUPERHEATERS, STEAM
Babcock & Wilcox Co., New York, N.Y.
Heine Safety Boiler Co., St. Louis, Mo.
Power Specialty Co., New York, N.Y.

SWEEPERS, BROOMLESS FLOOR
Wm. Firth, Boston, Mass. *p. 112*

TANKS
—Steel
Bass Foundry & Machine Co., Fort Wayne, Ind.
Bigelow Co., The, New Haven, Conn.
Coatesville Boiler Works, New York, N.Y.
Dillon Steam Boiler Works, D. M., Fitchburg, Mass. *p. 133*
Heine Safety Boiler Co., St. Louis, Mo.
Hodge Boiler Works, East Boston, Mass.
International Engineering Works, Inc., Framingham, Mass. *p. 153*
Koven & Brother, L. O., Jersey City, N.J.
Mohr & Sons, John, Chicago, Ill.
Phoenix Iron Works Co., Meadville, Pa.
Scaife & Sons Co., Wm. B., Pittsburgh, Pa.
Shevlin Engineering Co., Inc., New York, N.Y.
Struthers-Wells Co., Warren, Pa.
Union Iron Works, Erie, Pa.
Walsh & Weidner Boiler Co., The, Chattanooga, Tenn. *p. 155*
Washburn & Granger, New York, N.Y.
Wickes Boiler Co., The, Saginaw, Mich. *p. 102*
Wood & Co., R. D., Philadelphia, Pa.

TANKS, TUBS AND VATS
Allen Sons Co., Wm., Worcester, Mass.
Bigelow Company, The, New Haven, Conn.
Biggs Boiler Works, East Akron, O.
Caldwell Co., W. E., Louisville, Ky.
Chicago Bridge & Iron Works, New York, N.Y.
Dillon Steam Boiler Works, D. M., Fitchburg, Mass. *p. 154*
Hall & Sons, Amos H., Philadelphia, Pa.
International Engineering Works, Inc., Framingham, Mass. *p. 153*
New England Tank & Tower Co., Everett, Mass.
Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa.
Textile-Finishing Machinery Co., The, Providence, R.I. *p. 136*
Tolhurst Machine Works, Troy, N.Y. *p. 139*
Scaife & Sons, W. B., Pittsburgh, Pa.
Stearns, A. T., Lumber Co., Neponset, Mass.
Walsh & Weidner Boiler Co., The, Chattanooga, Tenn. *p. 155*

TAPE
—Spinning
Barber Mfg. Co., Lowell, Mass. *p. 128*

TAPE MACHINERY
Barber Mfg. Co., Lowell, Mass. *p. 128*

TAPES, BRAIDS, CORDS AND NARROW FABRICS
American Textile Binding Co., Inc., Philadelphia, Pa.
Gates, T. B. M., New York, N.Y.
Germantown Braid Co., Philadelphia, Pa.
Goff & Sons, D., Pawtucket, R.I.
Hooper Sons Mfg. Co., Philadelphia, Pa.
Industrial Tape Mills Co., Philadelphia, Pa.
Krout & Fite Mfg. Co., Philadelphia, Pa.
Macungie Silk Co., Macungie, Pa.
Small Bros., Fall River, Mass.
Steinthal & Co., M., New York, N.Y.
Street & Co., R. R., Chicago, Ill.
Wright Mfg. Co., Lawrence, Mass.

TELEPHONE SYSTEMS
Automatic Electric Co., Chicago, Ill.
Couch, Inc., S. H., Boston, Mass.
Western Electric Co., New York, N.Y.

TEMPERATURE CONTROLLERS
American Moistening Co., Boston, Mass. *p. 148*
Carrier Engineering Corp., New York, N.Y. *p. 149*
Cramer, Stuart W., Charlotte, N.C. *p. 151*
Parks Company, The, G. M., Fitchburg, Mass. *p. 150*

TENTERING MACHINES
Butterworth & Sons Co., H. W., Philadelphia, Pa. *p. 135*

TESTING APPARATUS, FABRIC
Draper Corporation, Hopedale, Mass. *p. 102*
Perkins, B. F. & Son, Inc., Holyoke, Mass.
Precision Instrument Co., Detroit, Mich.
Shuttle Machine Co., New York, N.Y.
Torsion Balance Co., New York, N.Y.

THERMOMETERS
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Bristol Co., Waterbury, Conn.
Brown Instrument Co., Philadelphia, Pa.
Combustion Appliances Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Foxboro Co., Foxboro, Mass.
Precision Thermometer & Instrument Co., Philadelphia, Pa.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Standard Thermometer Co., Boston, Mass.
Tagliabue Mfg. Co., C. J., Brooklyn, N.Y.
Taylor Instrument Co's., Rochester, N.Y.

THREAD, METAL
Montgomery Co., J. R., Windsor Locks, Conn. *p. 132*

TIME RECORDERS
Bristol Co., Waterbury, Conn.
Brown Instrument Co., Philadelphia, Pa.
Cincinnati Time Recorder Co., Cincinnati, O.
Howard Clock Co., The E., Boston, Mass.
International Time Recording Co., Endicott, N.Y.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Simplex Time Recorder Co., Gardner, Mass.
Stromberg Electric Co., Chicago, Ill.

TINSEL, COTTON
Montgomery Co., J. R., Windsor Locks, Conn. *p. 132*

TRADEMARKING MACHINERY
Curtis & Marble Machine Co., Worcester, Mass. *p. 114*
Parks & Woolson Machine Co., Springfield, Vt. *p. 115*

TRAPS
—Steam
Albany Steam Trap Co., Albany, N.Y.
American Blower Co., Detroit, Mich.
Anderson Co., V. D. N., Cleveland, O.
Automatic Steam Trap & Specialty Co., Cleveland, O.
Crane Co., Chicago, Ill.
D'Este Co., Julian, Boston, Mass.
Lytton Mfg. Corp'n, Franklin, Va.
Morehead Mfg. Co., Detroit, Mich.
Nashua Machine Co., Nashua, N.H.
Nason Mfg. Co., New York, N.Y.
Ohio Blower Co., Cleveland, O.
Pittsburgh Valve, Foundry & Const. Co., Pittsburgh, Pa.
Pratt & Cady Co., Inc., Hartford, Conn.
Sarco Company, Inc., New York, N.Y.
Simmons Co., John, New York, N.Y.
Sturtevant Co., B. F., Boston, Mass. *pp. 158–9*
Webster & Co., Warren, Camden, N.J.

TRAVELER CLEANERS
Whitinsville Spinning Ring Co., Whitinsville, Mass. *p. 122*

TRAVELERS, RING
National Ring Traveler Co., Providence, R.I. *p. 123*

TRUCKS
Barrett-Cravens Co., Chicago, Ill.
Clark Co., Geo. P., Windsor Locks, Conn.
Cowan Truck Co., Holyoke, Mass.
Diamond State Fibre Co., Bridgeport, Pa.
Elwell-Parker Electric Co., Cleveland, O.
Fairbanks Co., Boston, Mass.
Lakewood Engineering Co., Cleveland, O.
Lewis-Shepard Co., Boston, Mass.
National Scale Co., Chicopee Falls, Mass.
Stuebing Truck Co., Cincinnati, O.

TUBE CLEANERS, BOILER
Chesterton Co., A. W., Boston, Mass.
Lagonda Mfg. Co., Springfield, O.
Monarch Steam Blower Co., Troy, N.Y.
Pierce Co., Wm. B., Buffalo, N.Y.
Roto Co., Hartford, Conn.
Spencer Turbine Cleaner Co., Hartford, Conn.

TUBE WINDERS
Foster Machine Co., Westfield, Mass. *p. 124*

TUBES FOR WINDING
Universal Winding Co., Providence, R.I. *p. 125*

TUBING MACHINES
—Rubber
Royle & Sons, John, Paterson, N.J. *p. 140*

TURBINES
—Hydraulic
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Holyoke Machine Co., Holyoke, Mass.
Hunt Machine Co., Rodney, Orange, Mass.
Hydraulic Turbine Corp'n, Camden, N.J.
Leffel & Co., James, Springfield, O.
Pelton Water Wheel Co., San Francisco, Cal.
Platt Iron Works, Dayton, O.
Smith Co., S. Morgan, York, Pa.
Wellman-Seaver-Morgan Co., Cleveland, O.
—Steam
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
De Laval Steam Turbine Co., Trenton, N.J.
General Electric Co., Schenectady, N.Y.
Kerr Turbine Co., Wellsville, N.Y.
Southwark Foundry & Machine Co., Philadelphia, Pa.
Sturtevant Co., B. F., Boston, Mass. *pp. 158–9*
Terry Steam Turbine Co., The, Hartford, Conn.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. *p. 161*

TURBO-BLOWERS
Coppus Engineering & Equipment Co., Worcester, Mass.
De Laval Steam Turbine Co., Trenton, N.J.
General Electric Co., Schenectady, N.Y.
Ingersoll-Rand Co., New York, N.Y.
Kerr Turbine Co., Wellsville, N.Y.
Power Turbo-Blower Co., New York, N.Y.
Southwark Foundry & Machine Co., Philadelphia, Pa.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. *p. 161*
Worthington Pump & Machinery Corp'n, New York, N.Y.

TURBO-PUMPS
Coppus Engineering & Equipment Co., Worcester, Mass.
De Laval Steam Turbine Co., Trenton, N.J.
Kerr Turbine Co., Wellsville, N.Y.
Platt Iron Works, Dayton, O.
Terry Steam Turbine Co., The, Hartford, Conn.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. *p. 161*
Wheeler Condenser & Engineering Co., Carteret, N.J.

TWINE
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Universal Winding Co., Providence, R.I. *p. 125*

TWISTING MACHINERY
Draper Corporation, Hopedale, Mass. *p. 102*
Fales & Jenks Machine Co., Pawtucket, R.I. *p. 109*
Haskell-Dawes Machine Co., Boston, Mass.
H. & B. American Machine Co., Pawtucket, R.I. *p. 106*
Saco-Lowell Shops, Boston, Mass. *p. 101*
Smith & Furbush Machine Co., Philadelphia, Pa.
Whitin Machine Works, Whitinsville, Mass. *p. 104*

TWISTING TRAVELERS
(See Travelers, Ring)

TYING MACHINES, WARP
Barber-Colman Co., Rockford, Ill. *p. 129*

UNIONS
Crane Co., Chicago, Ill.
Dart Mfg. Co., Providence, R.I.
Jefferson Union Co., Lexington, Mass.
Walworth Mfg. Co., South Boston, Mass.

VALVE OPERATING MECHANISM
Babbitt Steam Specialty Co., New Bedford, Mass. *p. 147*

VALVES
Chapman Valve Mfg. Co., Indian Orchard, Mass.
Coffin Valve Co., Neponset, Mass.
Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Darling Pump & Mfg. Co., Ltd., Williamsport, Pa.
Dole Valve Co., Chicago, Ill.
Eddy Valve Co., Waterford, N.Y.
Homestead Valve Mfg. Co., Pittsburgh, Pa.
Jenkins Bros., New York, N.Y.
Kelly & Jones Co., Greensburg, Pa.
Kennedy Valve Mfg. Co., Elmira, N.Y.
Ludlow Valve Mfg. Co., Troy, N.Y.
Lunkenheimer Co., The, Cincinnati, O.
McNab & Harlin Mfg. Co., New York, N.Y.
Marsh Valve Co., Erie, Pa.
Nelson Valve Co., Philadelphia, Pa.
Ohio Brass Co., Mansfield, O.
Pittsburgh Valve & Fittings Co., Barberton, O.
Pittsburgh Valve, Foundry & Const. Co., Pittsburgh, Pa.
Powell Co., William, Cincinnati, O.
Pratt & Cady Co., Inc., Hartford, Conn.
Simmons Co., John, New York, N.Y.
Walworth Mfg. Co., South Boston, Mass.
Wood & Co., R. D., Philadelphia, Pa.

VARNISHES
(See Paints)

VENTILATING APPARATUS
American Blower Co., Detroit, Mich.
Buffalo Forge Co., Buffalo, N.Y. *p. 160*
Carrier Engineering Corp, New York, N.Y. *p. 149*
Sturtevant Co., B. F., Boston, Mass. *pp. 158–9*

VOLTMETERS
Biddle, James G., Philadelphia, Pa.
Bristol Co., Waterbury, Conn.
Brown Instrument Co., Philadelphia, Pa.
General Electric Co., Schenectady, N.Y.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. *p. 161*

WARP COMPRESSORS
Warp Compressing Mch. Co., Worcester, Mass. *p. 116*

WARP STOP MOTIONS
Crompton & Knowles Loom Wks., Worcester, Mass. *p. 103*
Draper Corporation, Hopedale, Mass. *p. 102*
Firth, William, Boston, Mass. *p. 112*

WARPERS
(See Beaming and Warping Machinery)

WARPS, COTTON
Montgomery Co., J. R., Windsor Locks, Conn. *p. 132*

WASH ROOM EQUIPMENT
Manufacturing Equip. & Engrg. Co., Framingham, Mass.
Mott Iron Works, J. L., Trenton, N.J.
Speakman Supply and Pipe Co., Wilmington, Del.
Standard Sanitary Mfg. Co., Pittsburgh, Pa.

WASHERS (Cloth)
Buhlmann, A. W., New York, N.Y.
Butterworth & Sons Co., H. W., Philadelphia, Pa. *p. 135*
Hunt Machine Co., Rodney, Orange, Mass.
Hunter Machine Co., James, North Adams, Mass.
Jefferson, Edward, Philadelphia, Pa.
Philadelphia Drying Machinery Co., Philadelphia, Pa.
Street & Co., R. R., Chicago, Ill.
Textile-Finishing Machinery Co., The, Providence, R.I. *p. 136*

WASTE RECLAIMING MACHINERY
Saco-Lowell Shops, Boston, Mass. *p. 101*
Whitin Machine Works, Whitinsville, Mass. *p. 104*

WATER PURIFYING PLANTS
Detroit Steam Appliance Co., Detroit, Mich.
Harrison Safety Boiler Works, Philadelphia, Pa.
Hungerford & Terry, Inc., Philadelphia, Pa. *p. 172*
International Filter Co., Chicago, Ill.
Loomis-Manning Filter Distributing Co., Philadelphia, Pa.
New York Continental Jewell Filtration Co., New York, N.Y.
Pittsburgh Filter Mfg. Co., Pittsburgh, Pa.
Scaife & Sons Co., Wm. B., Pittsburgh, Pa.

WATER SOFTENERS
American Water Softener Co., Philadelphia, Pa.
Dearborn Chemical Co., Chicago, Ill.
Detroit Steam Appliance Co., Detroit, Mich.
Harrison Safety Boiler Works, Philadelphia, Pa.
Industrial Filter Co., Chicago, Ill.
Michigan Engineering Co., Detroit, Mich.
Permutit Co., New York, N.Y.
Refinite Co., Des Moines, Ia.
Scaife & Sons Co., Wm. B., Pittsburgh, Pa.

WATER WHEELS
(See Turbines, Hydraulic)

WHEELS, SPROCKET, FOR VALVES
Babbitt Steam Specialty Co., New Bedford, Mass. *p. 147*

WINDERS
Allen, A. W., Philadelphia, Pa.
Altemus, J. K., Philadelphia, Pa.
Crompton & Knowles Loom Works, Worcester, Mass. *p. 103*
Easton & Burnham Machine Co., Pawtucket, R.I. *p. 110*
Firth, William, Boston, Mass. *p. 112*
Foster Machine Co., Westfield, Mass. *p. 124*
General Processing Co., Philadelphia, Pa.
Grosser Knitting Machine Co., New York, N.Y.
Jefferson, Edward, Philadelphia, Pa.
Leigh & Butler, Boston, Mass. *p. 113*
Lever Co., Inc., Oswald, Philadelphia, Pa.
Lindsay, Hyde & Co., Philadelphia, Pa.
Payne Co., Geo. W., Pawtucket, R.I.
Pratt, Robert G., Worcester, Mass.
Saco-Lowell Shops, Boston, Mass. *p. 101*
Smith & Furbush Machine Co., Philadelphia, Pa.
Spindler, E. O., New York, N.Y.
Universal Winding Co., Boston, Mass. *p. 125*
Windle, J. E., Worcester, Mass.

WINDERS AND DOUBLERS, CLOTH
Curtis & Marble Machine Co., Worcester, Mass. *p. 114*
Foster Machine Co., Westfield, Mass. *p. 124*
Parks & Woolson Machine Co., Springfield, Vt. *p. 115*
Windle, J. E., Worcester, Mass.

WINDOWS
—Metal
Badger & Sons, E. B., Boston, Mass. *p. 168*
Drouve Co., G., Bridgeport, Conn.
Detroit Steel Products Co., Detroit, Mich.
Lupton's Sons Co., David, Philadelphia, Pa.

WIRE, WOVEN
Clinton Wire Cloth Co., Clinton, Mass.
Morss & Whyte Co., The, Cambridge, Mass.
Page Steel & Wire Co., Adrian, Mich.
Wright Wire Co., Worcester, Mass.

WIRES AND CABLES, ELECTRICAL
American Brass Co., Waterbury, Conn.
American Steel & Wire Co., Chicago, Ill.
Electric Cable Co., The, New York, N.Y.
General Electric Co., Schenectady, N.Y.
Habirshaw Electric Cable Co., New York, N.Y.
Simplex Wire & Cable Co., Boston, Mass.
Western Electric Co., Inc., New York, N.Y.

YARD NUMBERING MACHINERY
Parks & Woolson Machine Co., Springfield, Vt. *p. 115*

YARNS, COTTON
Catlin & Co., New York, N.Y.
Eastern Yarn Co., Boston, Mass.
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Hooper Sons Mfg. Co., Philadelphia, Pa.
Johnston Mfg. Co., Philadelphia, Pa.
Lings & Co., G. S., New York, N.Y.
Littauer & Co., Inc., Ludwig, New York, N.Y.
Manley & Johnson, New York, N.Y.
Miller & Co., H. K., Boston, Mass.
Mitchell Co., James E., Philadelphia, Pa.
Montgomery Co., J. R., Windsor Locks, Conn. *p. 132*
Monument Mills, Housatonic, Mass.
Orswell Mills, Fitchburg, Mass.
Paulson, Linkroum & Co., New York, N.Y. *p. 131*
Plowman & Co., C. M., Philadelphia, Pa.
Quisset Mill, New Bedford, Mass.
Robison & Son, Inc., G., New York, N.Y.
Salkeld & Bro., Inc., A. D., New York, N.Y
Simons, H. F., New York, N.Y.
Street & Co., John F., Providence, R.I.
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